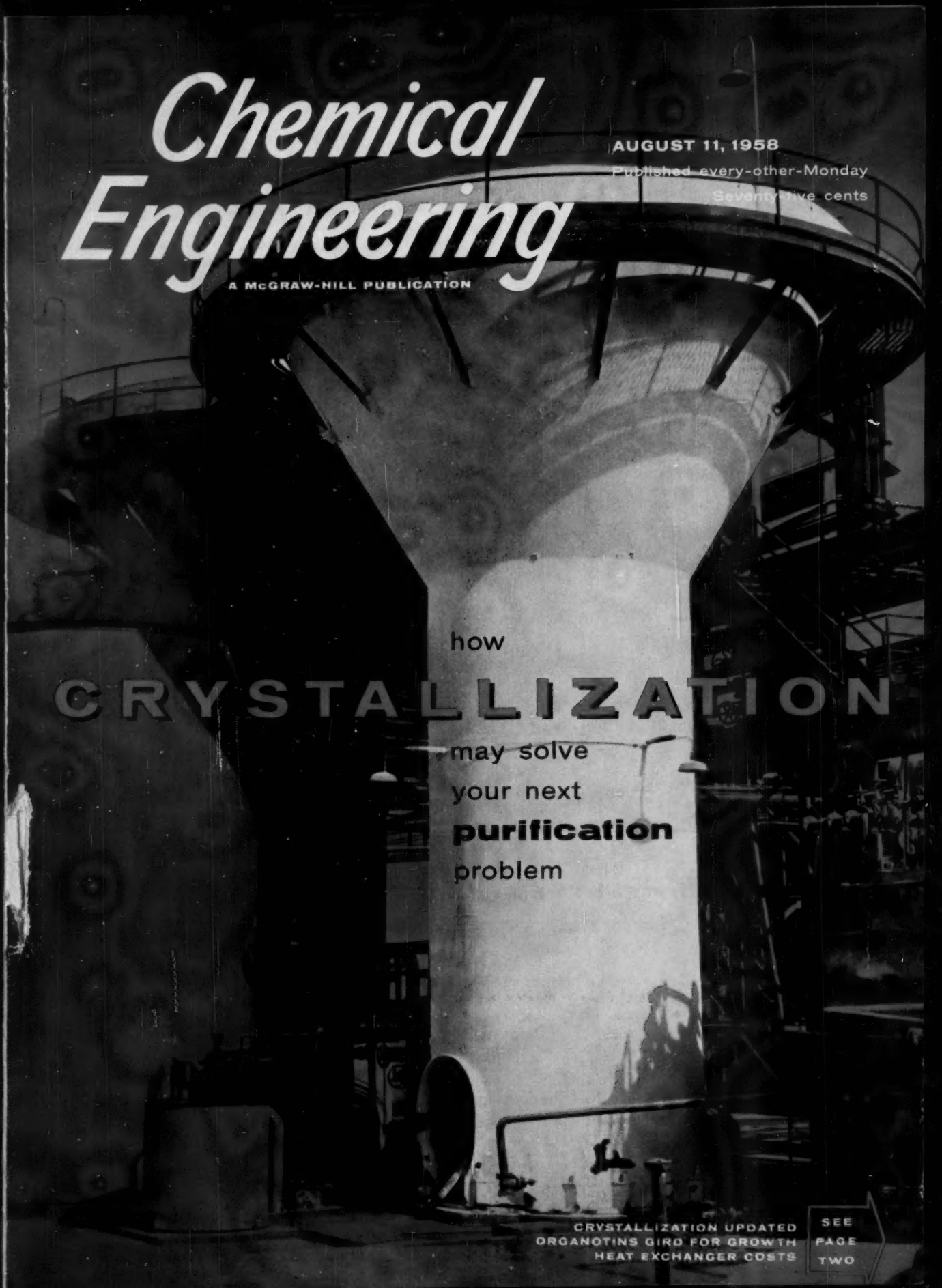
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AUGUST 11, 1958

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how

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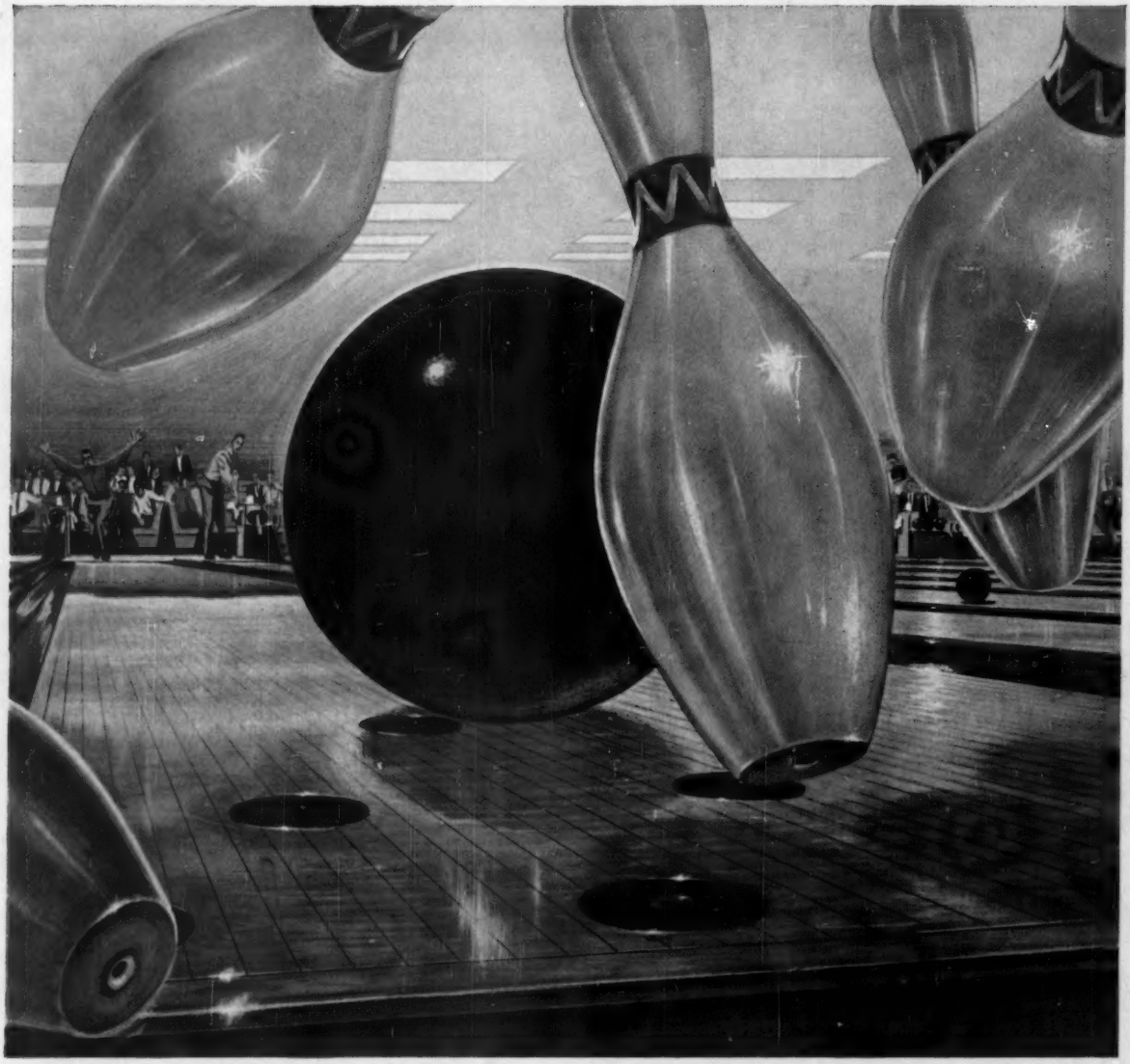
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BELOW — A few of the far-flung projects designed and constructed by Lummus

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High Pressure Acetylene Chemicals Plant, General Aniline & Film Corp.	Calvert City, Kentucky, U.S.A.
Phenol-Acetone Plant, Progil-Electrochimie	Pont de Claix, France
Ethylene Oxide Plant for Petrochemicals Ltd.	Partington, England

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SIXTEENTH OF TWENTY-SIX ISSUES

16/26

All about crystallization today

It's more than a comprehensive review of an important unit operation. Your CE Report brings together new and timely information that can't be found anywhere else in the literature. Its special features show how theory directs design and operation; how to pick equipment and how much it will cost. (p. 125)

19 Organometallics in full scale production

How dibutyl tin dilaurate and other organometallics are now being turned out on a commercial scale to meet the rising demands for these exotic products. (p. 78)

How to steam trace glass pipe

Copper sheaths can solve the problem of steam-tracing glass pipelines. This novel prize-winning idea can be used to keep your nonmetallic process lines hot, too. (p. 152)

What's new in fluorocarbon plastics

Modified compositions and better fabrication techniques are now bringing important new plastics into the chemical engineers' battle against corrosion. (p. 158)

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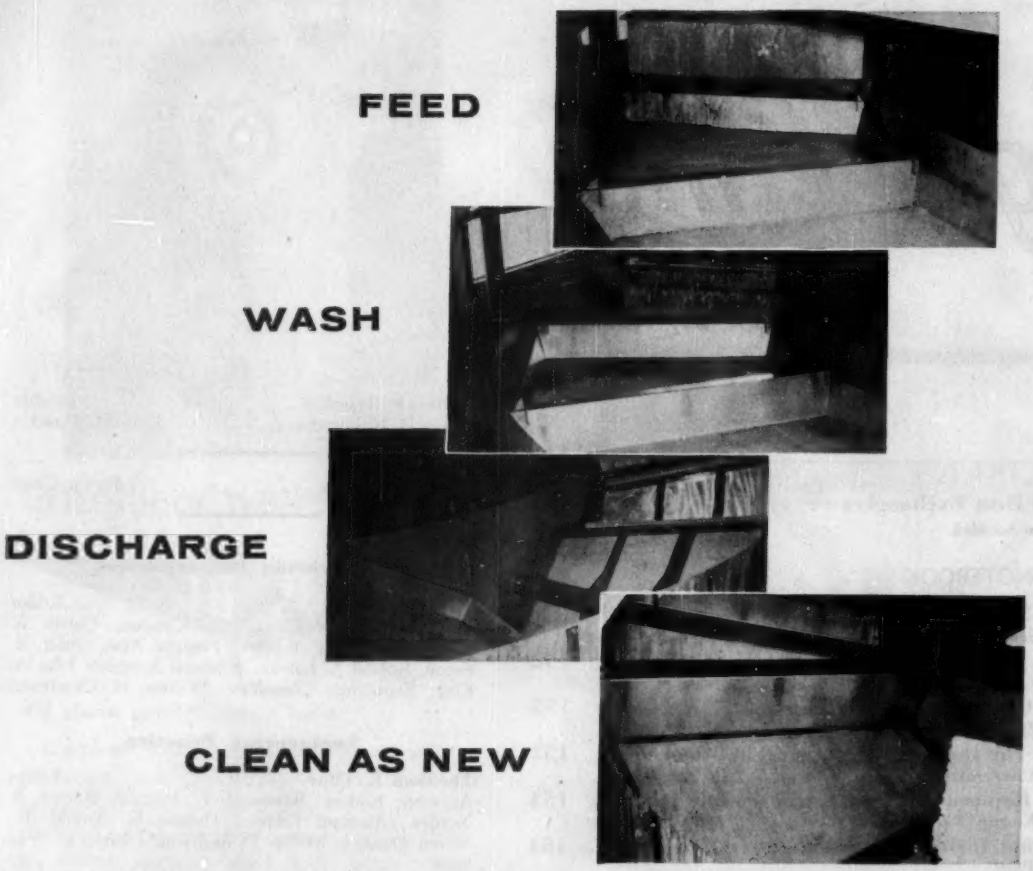
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This **BIRD-PRAYON** Continuous, Tilting Pan, Horizontal Filter dewaters and washes ***1.4 tons of solids per square foot per hour. Cake moisture gets down to eight per cent***

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Chemical Engineering

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Petrochemicals & Petroleum Refining

New ethylene plant adopts data-handling unit..... 84

Offering major operating improvements, Phillips Petroleum Co.'s new data-handling system lays the basis for eventual change to "closed-loop," computer-controlled operation.

You can use modern crystallization techniques..... 125

This 16-page crystallization report brings you up to the minute on a purification technique that's gaining wider interest among petroleum and petrochemical processors.

Use transfer unit in mass transfer calculations..... 147

In using the transfer unit, you'll find your calculations simpler, less sensitive to changes in flow rate—especially for continuous direct contacting between fluid streams.

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If you need to get quick estimates on costs for different types of heat exchangers, here's a cost file that gives one curve with factors covering a series of exchangers.

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Working with Hastelloy is a Talent at...



Vulcan manufacturing

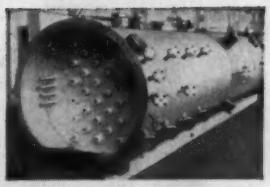
Because Hastelloy offers such a high degree of corrosion resistance, it's a natural choice for many applications in today's chemical processes. However, like many special alloys, it calls for unusual care and expertness in fabrication.

In the application illustrated at the left, Vulcan Manufacturing lined a carbon steel kettle with nearly four tons of Hastelloy C. This job required not only safeguards against cracking but full protection against carbon steel pick-up as well.

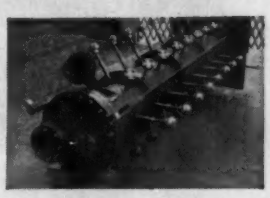
In successfully producing this Hastelloy-lined still kettle, Vulcan has again demonstrated a talent to handle the specialized jobs that are more and more becoming a part of today's process equipment.

When your plans call for dependable know-how in fabricating key components for chemical processes, remember Vulcan Manufacturing. For here's a talent that manifests itself in black ink – which we think is the real end product you look for.

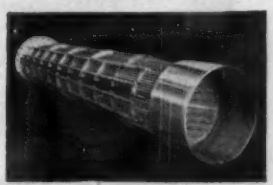
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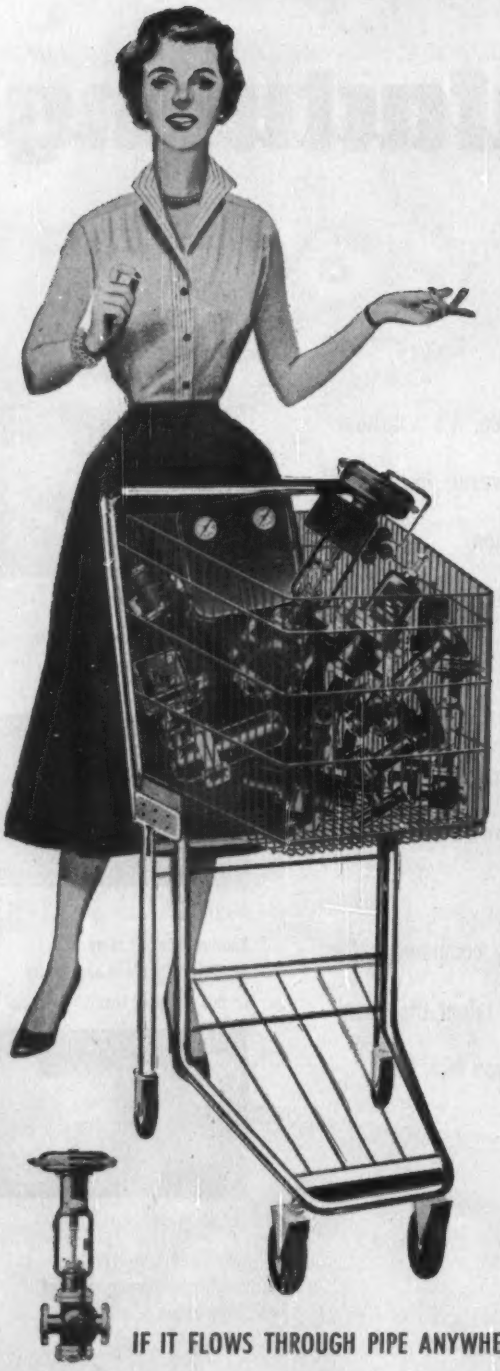


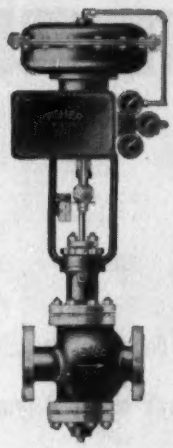
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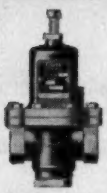




Type 657-A with 3500 Positioner



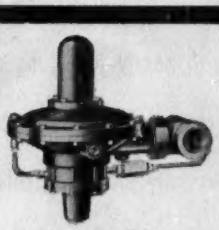
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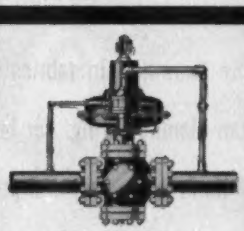
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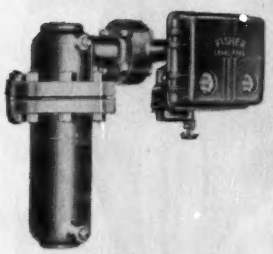


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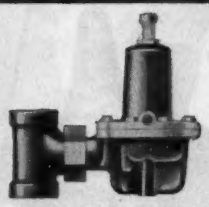
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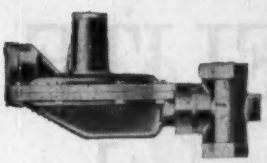


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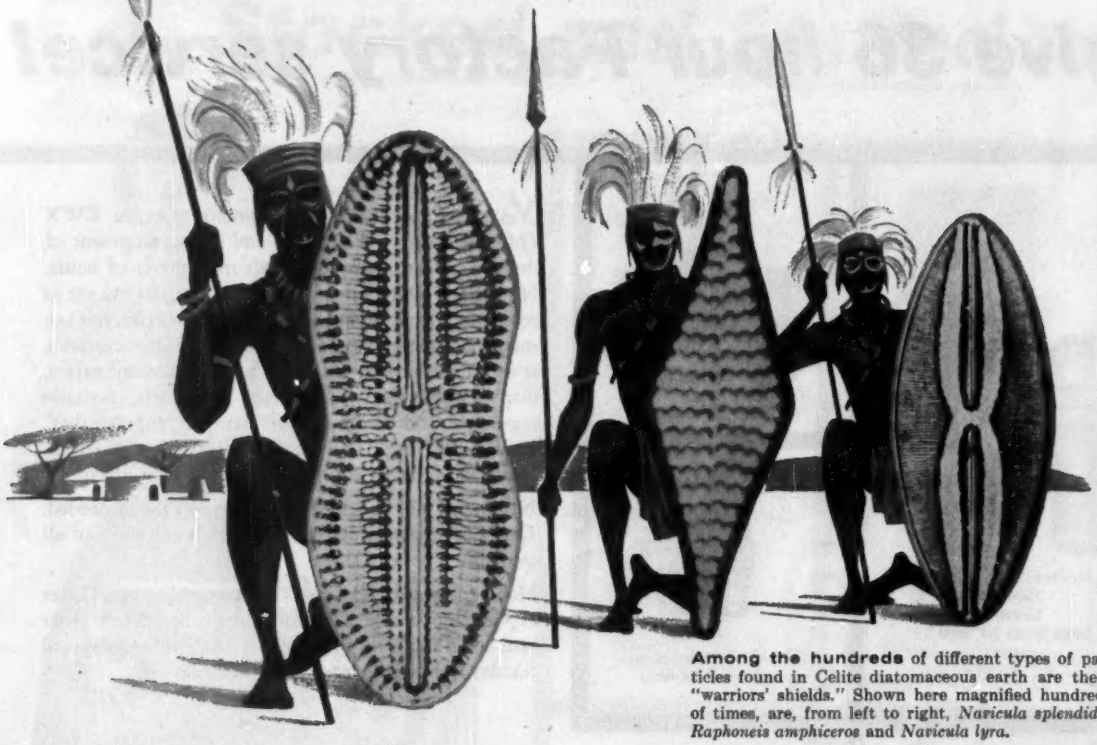
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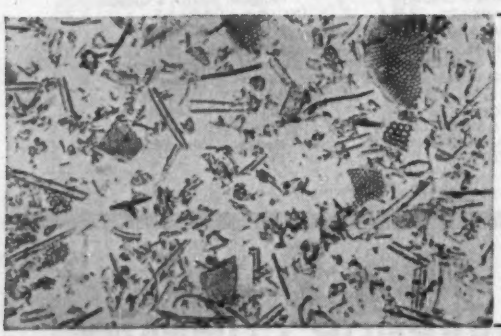
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Among the hundreds of different types of particles found in Celite diatomaceous earth are these "warriors' shields." Shown here magnified hundreds of times, are, from left to right, *Navicula splendida, Raphoneis amphiceros* and *Navicula lyra.*

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Celite's unique diatomite structure is shown in this photomicrograph. The infinite variety of particle shapes and sizes gives Celite its exceptional performance characteristics in a wide range of process applications.

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-the diatomite mineral filler soaks up dirt-controls gloss

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It requires 40 million whole or fragmentary particles to form a cubic inch of crude Celite. Consequently, even when added in small proportions, their properties are greatly magnified and widely dispersed throughout a formulation.

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Nickel Nitrate — Nickel Sulfate
Sodium Methoxide — Zinc Nitrate

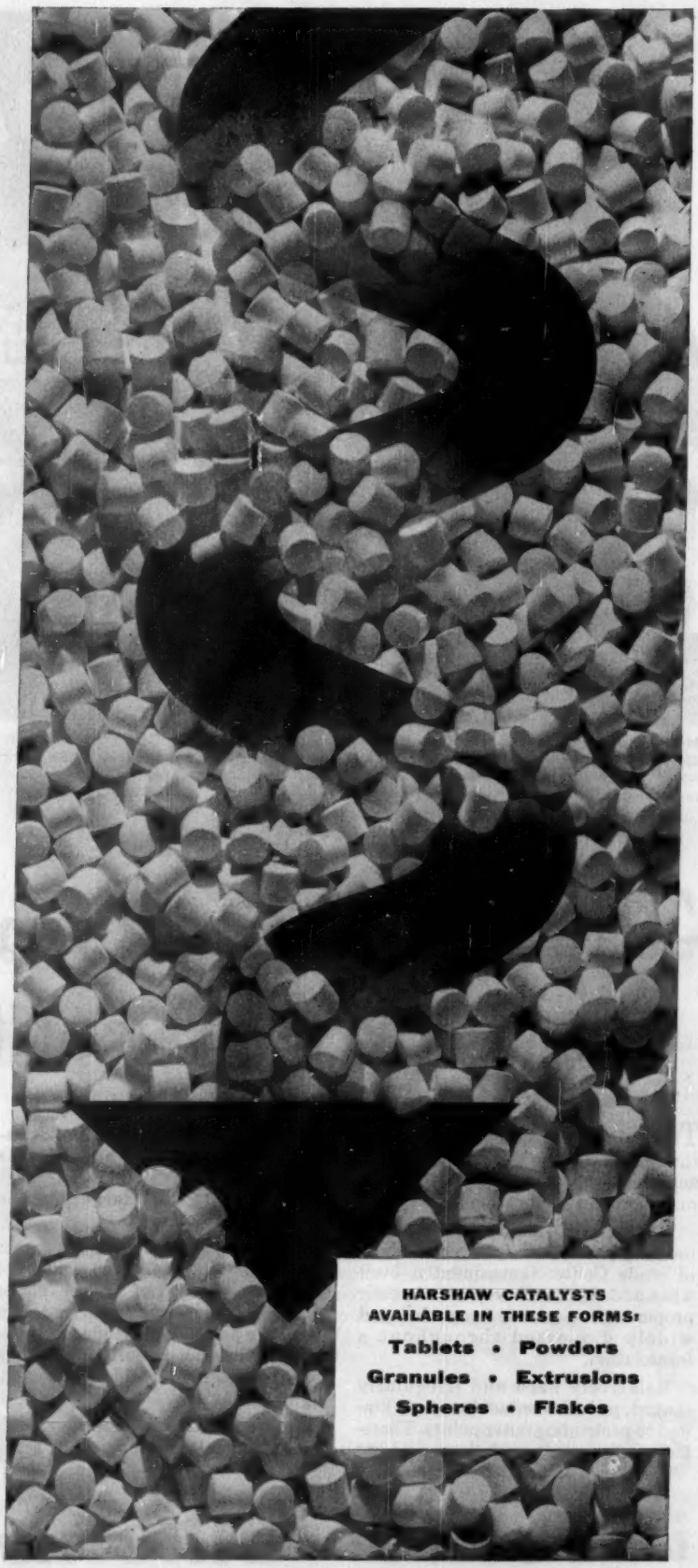
Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.



Write for Free Book

THE
HARSHAW CHEMICAL
COMPANY

Chicago • Cincinnati • Cleveland • Detroit
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HARSHAW CATALYSTS AVAILABLE IN THESE FORMS:

Tablets • Powders
Granules • Extrusions
Spheres • Flakes

like the chimes that bring good news



Hackney chimes bring longer profitable lives to stainless steel drums

With smooth, crack-free bottoms, reinforced by special welded chimes, Hackney stainless steel drums clean easier, save more on maintenance costs.

Whether storing or shipping foods or other products, corrosion-resistant stainless steel guards against all contamination. Durable yet lightweight, these drums cut shipping and handling costs in a hurry.

Available in 30-, 50- and 55-gallon capacities. Equipped with a single bolt type or a quick-acting Toggle-tite clamp closure to provide a liquid-tight returnable drum.



Special Hackney welded chime is easy to clean, strong and durable. I-bar hoops eliminated when a straight side container is required. Nickel or Monel drums available upon request.

Pressed Steel Tank Company

Manufacturer of Hackney Products

1447 South 66th Street, Milwaukee 14, Wisconsin

Branch offices in all principal cities

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS

Hackney

GRANULAR MATERIALS PREPARATION by KENNEDY VAN SAUN

Whatever the industry . . . electrochemical . . . carbon and graphite . . . ceramics . . . powder metallurgy . . . solid rocket fuels . . . whatever the operation . . . crushing, screening and grinding . . . batch or continuous . . . blending or mixing . . . extrusion or briquetting . . . a KENNEDY designed system will provide economy of operation and uniformity of product.

From the design and engineering of seventeen new or modernized carbon paste plants for the aluminum and electrochemical industries, KENNEDY has given effect to the principle of exact control over

- **Particle size gradation**
- **Weight proportions**
- **Consistency of product**

Every industry depending on the careful and controlled sizing, grading and proportioning of a solid raw material can profit from the experience and successes of the KENNEDY VAN SAUN Organization.

COST IS LOWERED because operation is automatic. Control is centralized . . . one panelboard monitors and regulates all operations.

AVAILABILITY IS ASSURED by the proven dependability of KENNEDY components and KENNEDY's integrated design.

FLEXIBILITY IS POSSIBLE . . . systems can be designed to produce many gradations of particle size simultaneously.

UNIFORMITY IS ASSURED by the precision with which each component performs its task.*

**As an example, the KENNEDY Air Swept Ball Mill System can be adjusted to produce and maintain from 38% to 90% passing 200 mesh with control of fines and coarse ends.*

KENNEDY's engineering and manufacturing approach is comprehensive. Preliminary surveys and studies . . . research and pilot programs . . . process design . . . equipment layout . . . coordination and supervision of manufacturing, construction and start-up . . . any or all of these services, as required, make up KENNEDY's integrated engineering plan . . . a plan that has proven its value to customers all over the world.

Write NOW for detailed engineering data to . . .

Industrial Division

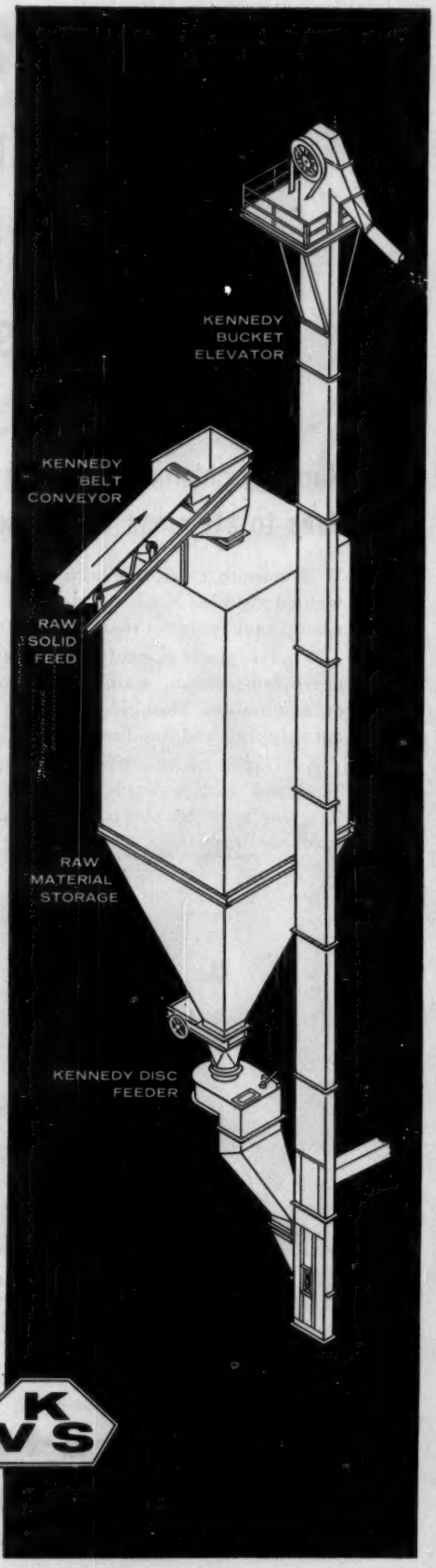
KENNEDY VAN SAUN

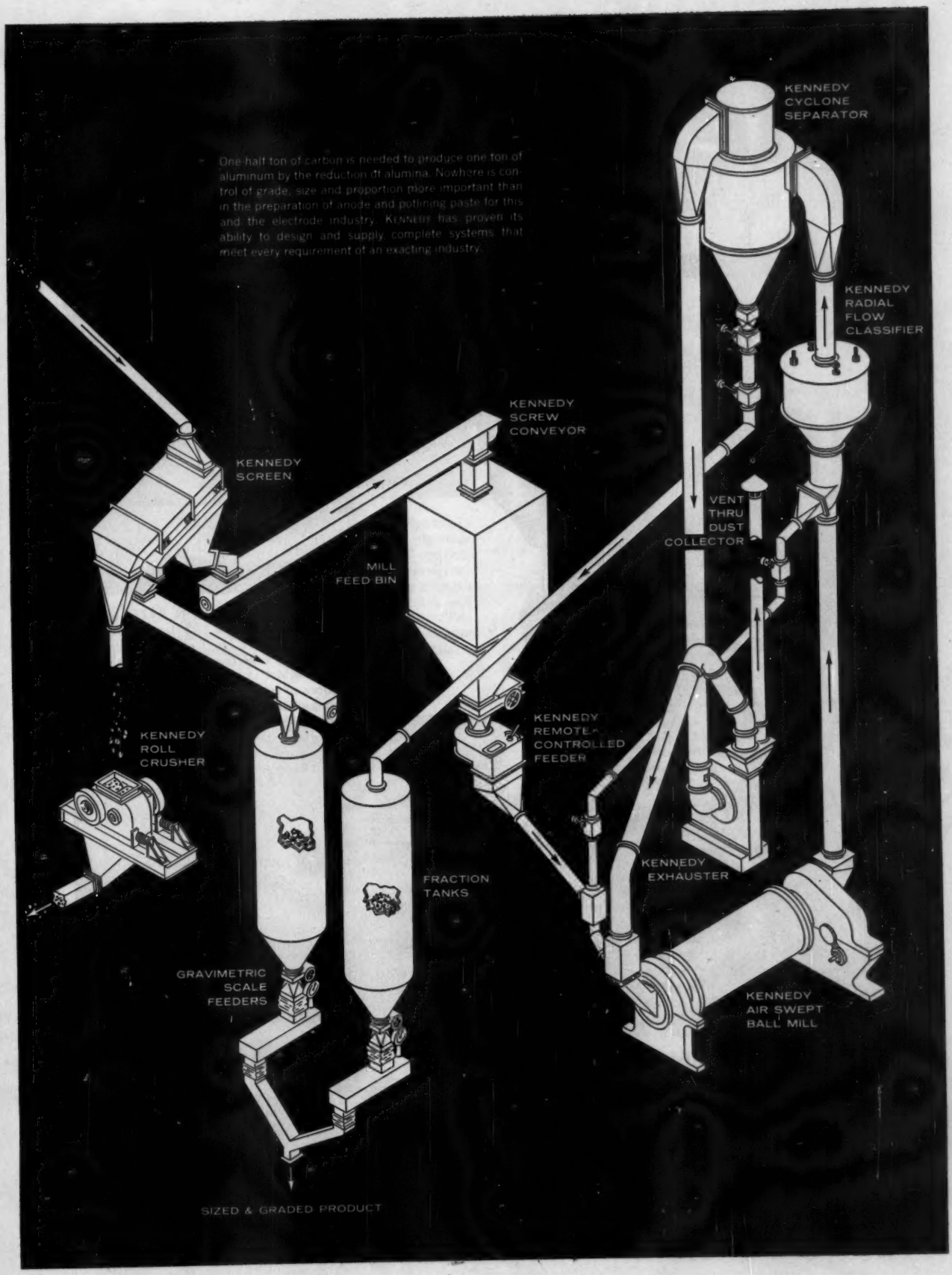
MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N. Y. • FACTORY: DANVILLE, PA.

COMPLETE CRUSHING, LIME, CEMENT & CARBON PASTE PLANTS
KENNEDY RESEARCH & TESTING SERVICE

PRIMARY & SECONDARY GYRATORY CRUSHERS • JAW CRUSHERS • ROLL CRUSHERS • IMPACT BREAKERS • HAMMER MILLS • ROD & BALL MILLS • KILNS • DRYERS • SCREENS • CONVEYORS




One half ton of carbon is needed to produce one ton of aluminum by the reduction of alumina. Nowhere is control of grade, size and proportion more important than in the preparation of anode and potlining paste for this and the electrode industry. KENNEDY has proven its ability to design and supply complete systems that meet every requirement of an exacting industry.
KENNEDY CYCLONE SEPARATOR
KENNEDY RADIAL FLOW CLASSIFIER
KENNEDY SCREW CONVEYOR
KENNEDY SCREEN
VENT THRU DUST COLLECTOR
MILL FEED BIN
KENNEDY REMOTE-CONTROLLED FEEDER
KENNEDY ROLL CRUSHER
KENNEDY EXHAUSTER
FRACTION TANKS
GRAVIMETRIC SCALE FEEDERS
KENNEDY AIR SWEPT BALL MILL
SIZED & GRADED PRODUCT

Life on the Chemical Newsfront

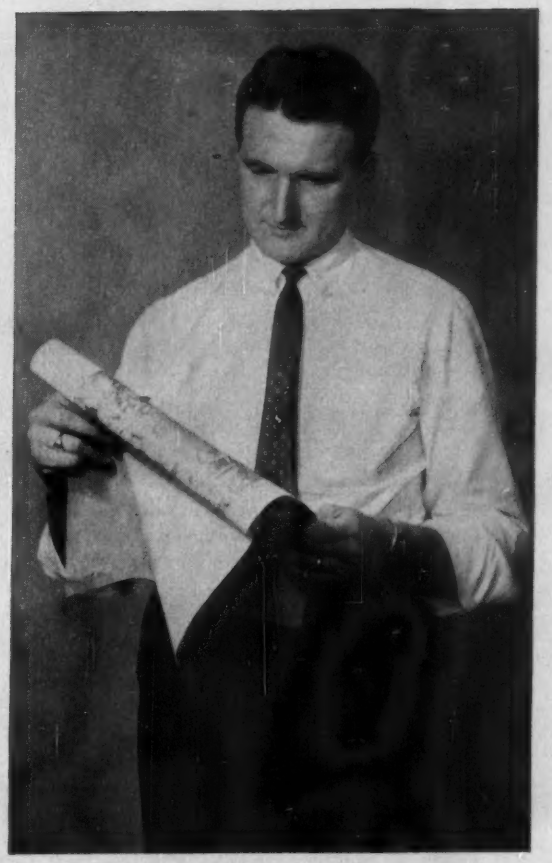


HIGHER WET STRENGTH IN PAPER can be secured with 30% to 60% less resin with Cyanamid's new HE (high efficiency) Process.† Intensive field tests have proved that the new HE Process not only provides unprecedented reductions in resin costs, it also makes possible the production of "super" wet strength papers with properties never before obtainable. Details of this process and its licensing can be secured through your Cyanamid Paper Chemicals Department Representative. **(Industrial Chemicals Div.)**

NEW RESINS GIVE EXCELLENT DURABILITY in the roughest application around the home—appliance finishes. Recently introduced CYZAC® *coating resins* offer an unusual combination of maximum hardness and scratch resistance with much greater impact and chemical resistance than other finishes. Baked CYZAC resin enamels also offer the high initial gloss and gloss retention that give that long-lasting "like new" appearance to appliances, metal furniture and cabinets. **(Plastics and Resins Division)**



WHITE RUBBER GETS "LIFE INSURANCE" from Cyanamid's UNITANE® *titanium dioxide*. Among the whitest pigments known, UNITANE is produced from materials that undergo thorough purification and careful quality control in manufacture to ensure maximum whiteness, high brightening strength and good aging characteristics. Longer-lasting whites and brighter pastels are assured in rubber and many other allied products by choosing one of the several grades of UNITANE titanium dioxide pigments. **(Pigments Division)**



WHITER WHITES ON SHARP UPGRADE. The strong trend to whiter whites—and brighter pastels—is evident in both paper and fabrics today, where CALCOFLUOR* *white fluorescent dyes* find increasing use. Papers upgraded by a small amount of CALCOFLUOR white look brilliantly white, more attractive, and also assure sharper halftone reproduction, as well as crisper, more legible printing. In cotton shirting, sheeting, and dress goods, CALCOFLUOR white counteracts yellowing of fabric, producing sparkling whites and clear, clean pastels. These CALCOFLUOR white brighteners are applied during paper or textile processing. In the finished product, they absorb ultraviolet light and re-emit it as visible light in the blue range of the spectrum. **(Organic Chemicals Division)**



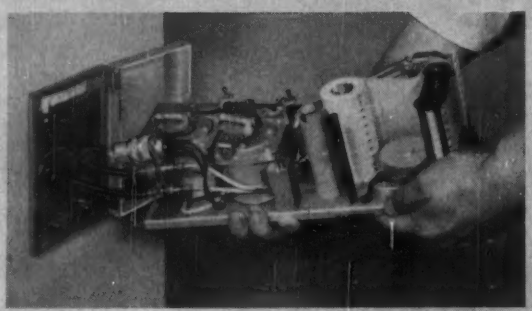
3-METHOXYPROPYLAMINE EXCELS in emulsifying agents for non-rubbing waxes and polishes. After the wax or polish is applied, 3-methoxypropylamine evaporates to deposit an irreversible glossy film of excellent water resistance. Both Fischer-Tropsch mineral waxes and emulsifiable polyethylene waxes lend themselves to this application. 3-methoxypropylamine can be used in much lower concentration than many other emulsifying components with equal or greater effectiveness. A data sheet outlining the use of 3-methoxypropylamine in waxes will be sent to you on request. **(Market Development Department)**

*Trademark
†Patent applied for by American Cyanamid Company

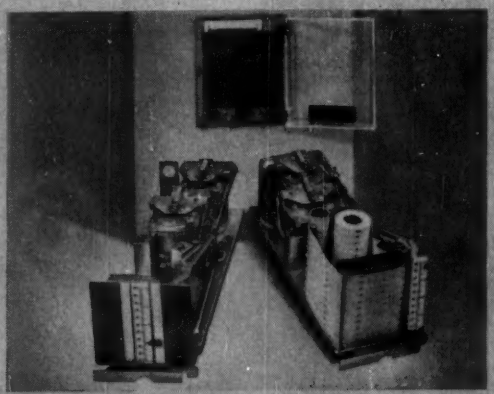
CYANAMID

AMERICAN CYANAMID COMPANY
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

For further information on these and other chemicals, call, write or wire American Cyanamid Company

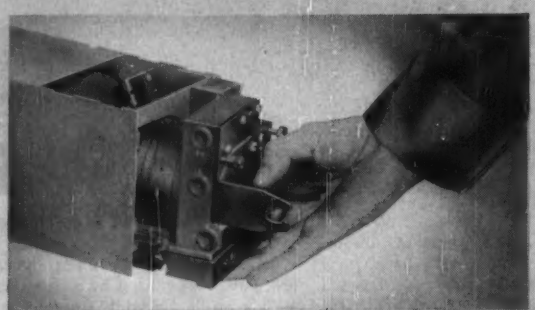


Easily Serviced—All parts can be inspected during operation, without process interruption. To remove chassis completely, unscrew three finger-tight, self-sealing connections.

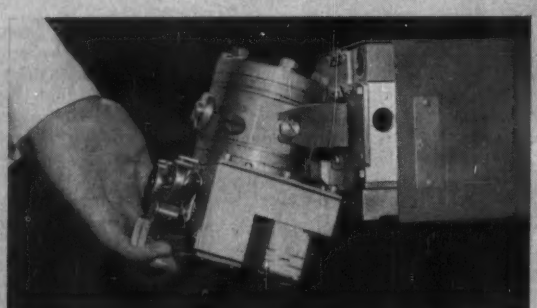


Interchangeable Chassis—Change recorder to indicator or vice versa without interrupting control. Simply pull out chassis, slide another in place.

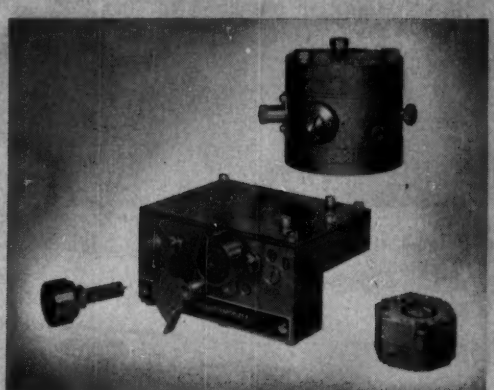
Now you can gain ... *Extra*



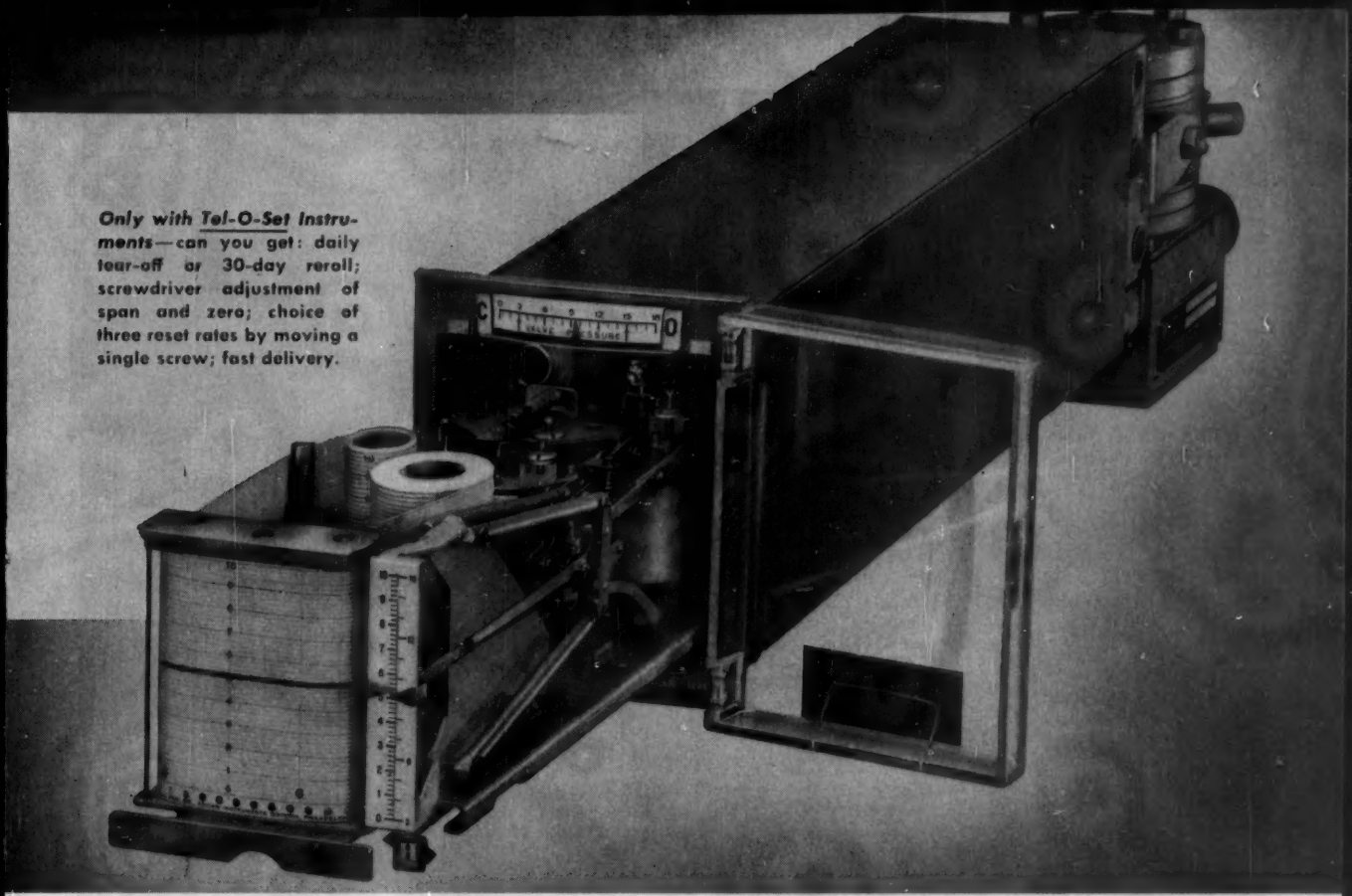
Removable Regulator—Pneumatic assembly, consisting of regulator and switches, can be removed from rear of case without disturbing electrical connections—no need for an electrician to stand by.



Quick-connect Mounting—Controllers have quick-connect switch permitting removal of the unit while process remains on manual control.



Easily Disassembled—Unitized construction of all controller components simplifies maintenance . . . makes reassembly foolproof. No need to dismantle stack to clean pilot assembly.



***Only with Tel-O-Set Instruments*—can you get: daily tear-off or 30-day reroll; screwdriver adjustment of span and zero; choice of three reset rates by moving a single screw; fast delivery.**

Savings with TEL-O-SET*

. . . advanced miniature pneumatic instruments

Tel-O-Set miniature instruments accurately record, indicate, and control process variables. They're applicable to any process variable . . . a saving in itself. And, further savings are accrued from these factors: Only a few models are needed for *all* applications . . . Personnel training time is minimized . . . Spare parts inventory is reduced . . . Process techniques can be changed without buying new instruments. The photographs point up some of the outstanding *Tel-O-Set* features.

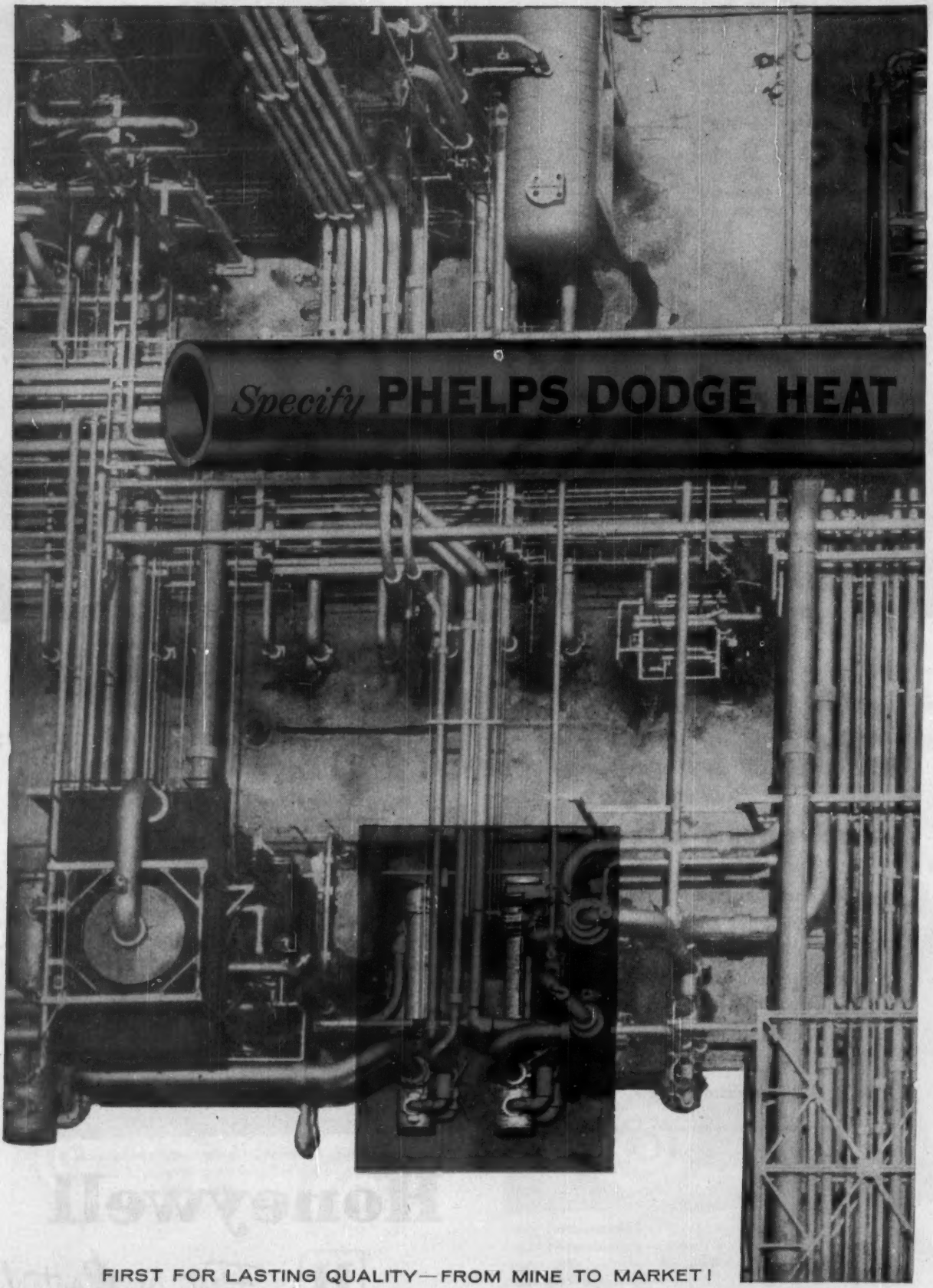
For complete information on *Tel-O-Set* instruments, write for Catalog C 100-1a, or call your nearby Honeywell field engineer. He's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

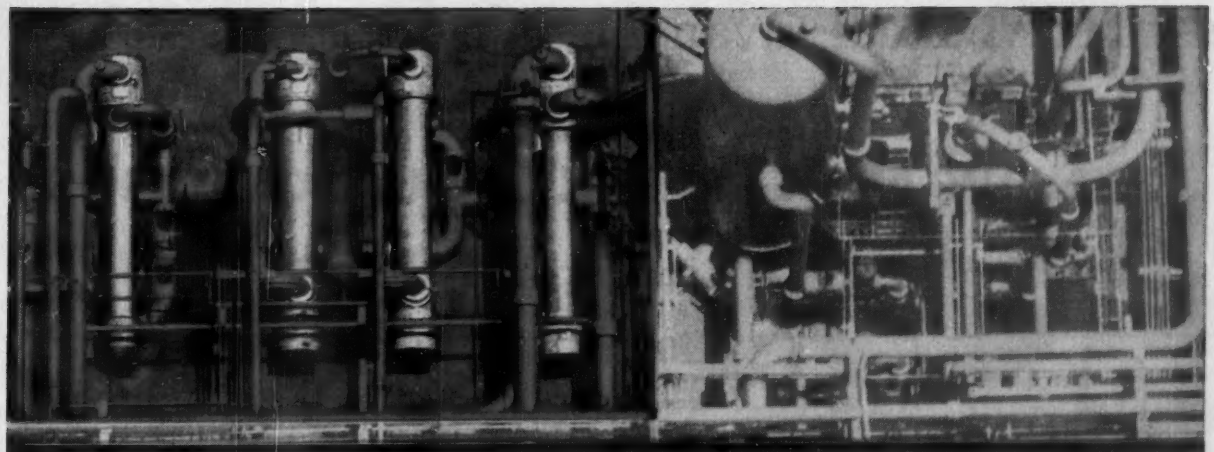
*Trade name Minneapolis-Honeywell Regulator Co.

Honeywell

H HONEYWELL *First in Control*

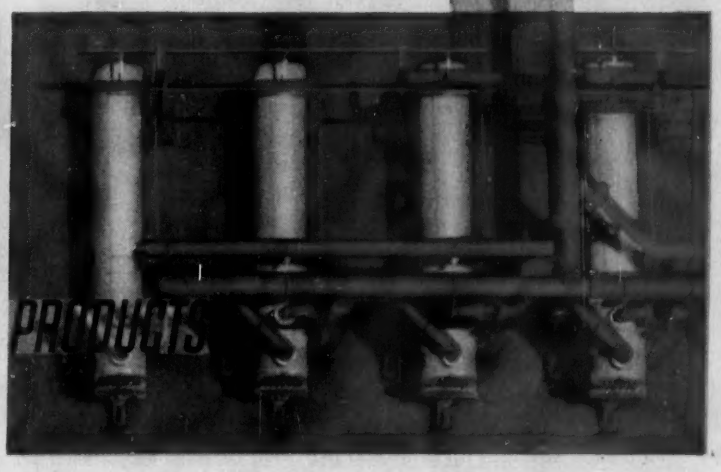


FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!



EXCHANGER TUBES *for Longer Service!*

- Full range of copper-base alloys for every application.
- Vast background of application engineering to assist in proper alloy selection.
- Complete control of quality throughout every step of manufacture.

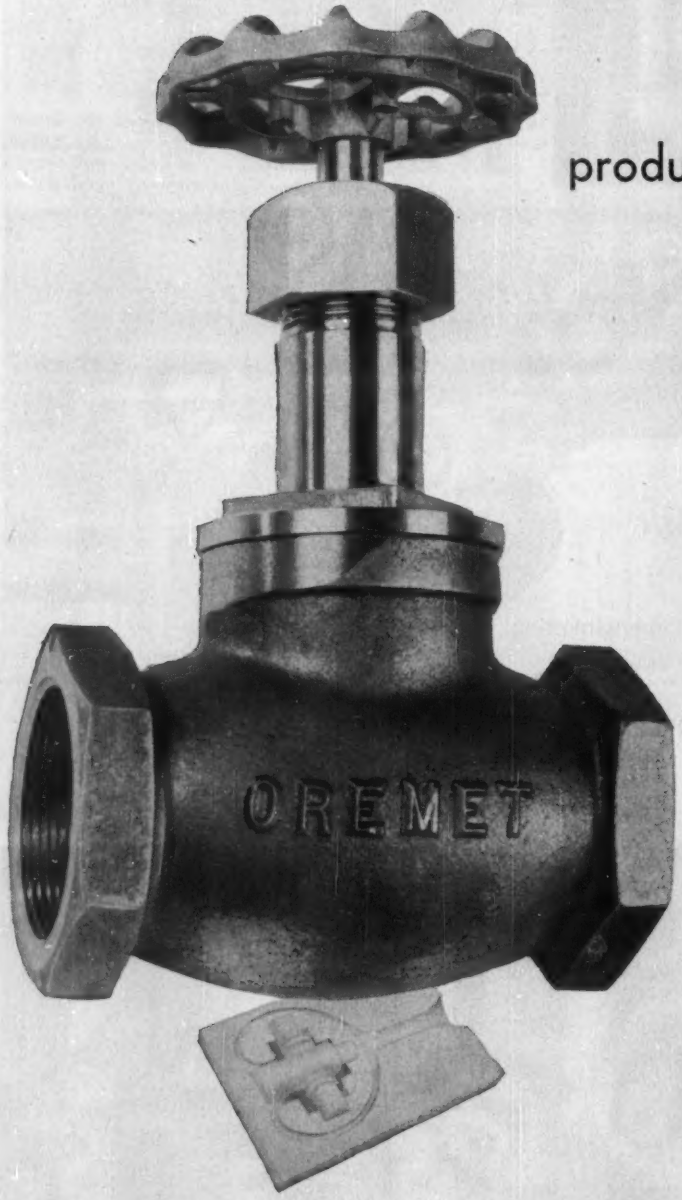


PHELPS DODGE COPPER PRODUCTS CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Fort Wayne, Greensboro, N. C., Houston, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

TITANIUM—available now for long service

NOW AVAILABLE: TITANIUM CASTINGS



• **This 2" titanium globe valve,** cast by Oregon Metallurgical Corp., is corrosion-resistant, has low density with a tensile strength up to 90,000 psi. Such castings are now possible by use of an expendable graphite mold composition developed through Du Pont research.

New casting technique produces sound, high-quality shapes at fraction of machined part cost

For the first time, *cast* titanium shapes are readily available—such as the globe valve pictured at left. One piece or a hundred can be produced at reasonable cost. This important development was made possible through the efforts of skilled foundrymen working with a new rammed graphite mold composition developed by Du Pont.

Sound, high-quality titanium castings are highly resistant to many corrosive environments such as hypochlorite slurries, brackish water and chlorinated organic compounds. Result: long service life, reduced downtime, lower initial and operating costs.

PIGMENTS DEPARTMENT

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

PIONEER PRODUCER OF

TITANIUM

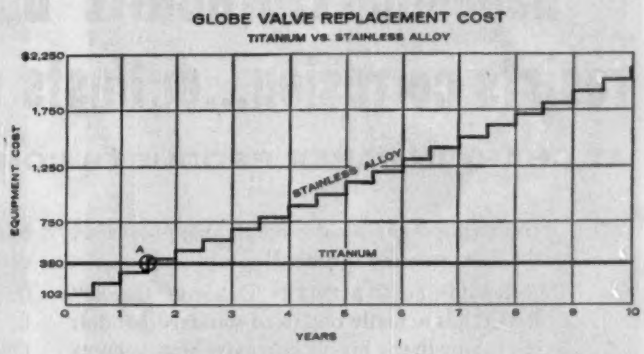
life . . . corrosion resistance . . . economy in use

Proven Economies

Titanium is actually the *least expensive* metal you can use under many corrosive influences. It withstands conditions that reduce the service life of ordinary and high-alloy metals . . . cuts downtime and replacements.

Titanium offers the economy of long, trouble-free service when exposed to such corrosive environments as:

- Salt Water
- Marine Atmospheres
- Nitric Acid
- Wet Chlorine
- Chlorinated Organic Compounds
- Most Inorganic Chloride Solutions
- Molten Sulfur
- Chromic Acid
- Aqua Regia
- Hypochlorites and Chlorine Dioxide



GREATER ECONOMIES are now possible through use of cast titanium valves. Stainless alloy and titanium globe valves were tested in an environment of 65% nitric acid at 110° C. Stainless alloy valve cost $102* . . . but had a *maximum* service life of only 6 months (some lasted only 3 months). The titanium valve cost $380*, showed no sign of corrosion after 6 months. Life expectancy: 10 years *minimum*. The $278 difference in cost was absorbed in less than 1½ years (Point A). After 10 years, a single titanium valve will save more than $1,750 in replacement costs alone!

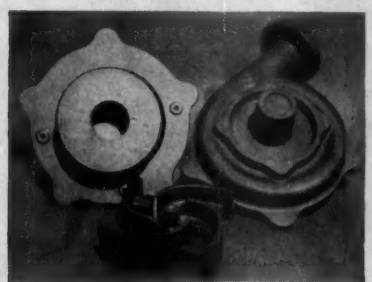
** cost of single unit*

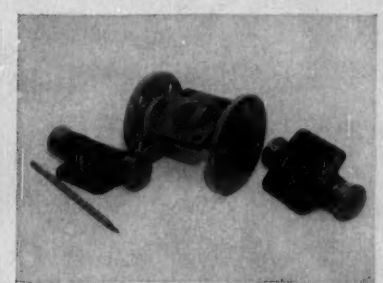
TITANIUM—available today

Titanium is now readily available for non-defense applications. Standard parts of titanium are already solving severe corrosion problems in the chemical, food, pulp, paper and allied industries.

In your process development work, take advantage of the corrosion and cavitation resistance, light weight, long life and high strength of titanium in continuous flow, high temperature and pressure processes.

As a manufacturer and pioneer producer of titanium sponge, Du Pont has been working with leading mill-products producers and process-equipment manufacturers on the commercial development of titanium. This broad experience can be applied to *your* process development, equipment design and plant maintenance problems. Just get in touch with Du Pont for further information about titanium—its properties and uses.







NOW AVAILABLE—*Cast* titanium parts and fitting like the centrifugal pump, diaphragm-type valve, and 5-in. IPS "Y" valve and accessories pictured above. These are just a few examples of commercial castings made of corrosion-resistant titanium.

MAIL COUPON TODAY for an informative booklet about titanium—its properties and applications. E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Titanium Market Development Section, Wilmington 98, Delaware. (This offer is limited to the United States and Canada.)

SPONGE



E. I. du Pont de Nemours & Co. (Inc.)
Titanium N-2420, CE-8, Wilmington 98, Delaware

Please send ☐ booklet on titanium, ☐ information on cast-titanium parts. I'm interested in titanium for the following applications:_____

Name _____ *Title* _____

Firm _____

Address _____

City _____ *Zone* _____ *State* _____

(Offer limited to the United States and Canada)

Republic ELECTRUNITE "Dekoron-Coated" E.M.T. resists corrosion...outlasts standard conduit 10 to 1

AT CHARMIN PAPER PRODUCTS COMPANY, GREEN BAY, WISCONSIN

Here's another typical example that proves . . . the *best* costs *less* installed!

Republic ELECTRUNITE® "Dekoron®-Coated" E.M.T. has actually outlasted standard conduit ten to one in the highly corrosive atmospheres of paper making at the Charmin Paper Products Company, Green Bay, Wisconsin.

At one time, sulfurous acid fumes from the mill's sulfite digester combined with moisture to corrode standard conduit so badly that it had to be renewed as often as every six months. Republic's "Dekoron-Coated" ELECTRUNITE E.M.T. was used to replace standard conduit.

Six years later, much of the original ELECTRUNITE installation is still in service.

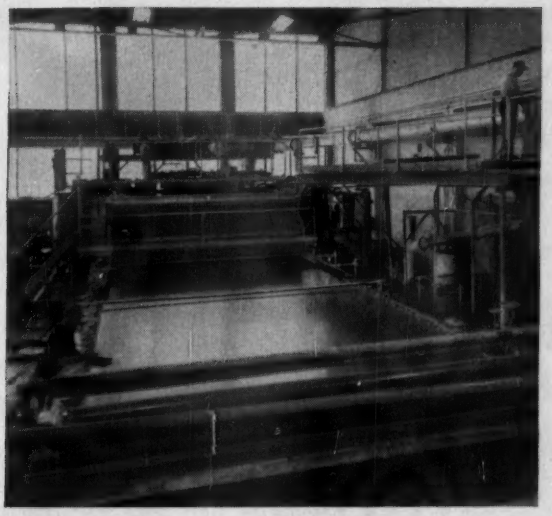
Here's why: ELECTRUNITE E.M.T. is produced from highest quality flat-rolled open-hearth steel made in Republic's own mills, carefully inspected to Republic's rigid manufacturing specifications. Tough, corrosive-proof polyethylene coating is applied over the galvanized finish, providing double protection against corrosion.

"Dekoron-Coated" E.M.T. is easy to install. It can be cut to length and bent to fit with ease. Moisture-tight, continuously grounded, corrosion-protected joints are made by wrapping the threadless connectors and couplings with plastic tape. Complete protection is assured from end-to-end throughout the run.

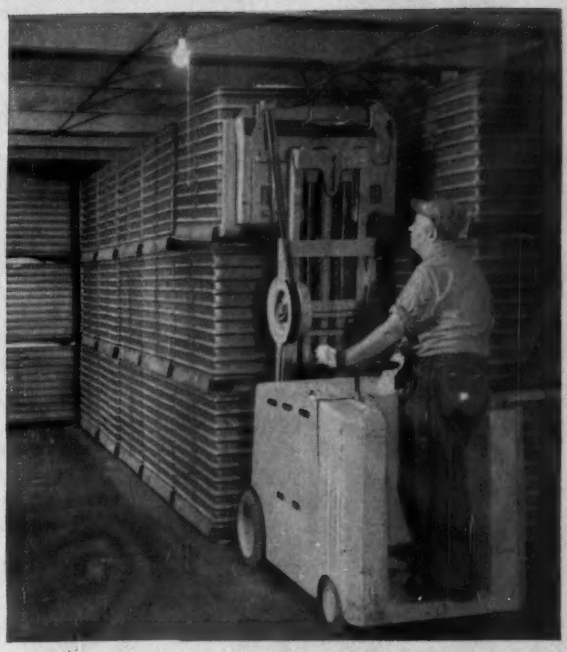
Republic ELECTRUNITE "Dekoron-Coated" E.M.T. costs less to install . . . less to maintain, meets electrical codes and specifications. Call your Republic representative or write today!

Republic ELECTRUNITE "Dekoron-Coated" E.M.T. outlasted standard galvanized carbon steel conduit ten to one over a six-year period at the Charmin Paper Products Company, Green Bay, Wisconsin. Major maintenance problems were eliminated.





CONVERSION TO STAINLESS STEEL PAYS OFF in cleanliness, uniform quality, minimum maintenance, and reduced costs at Allied Paper Corporation, Kalamazoo, Michigan. Older equipment, made from less versatile materials, is being replaced with equipment fabricated from Republic ENDURO® Stainless Steel. Allied is already enjoying a 50% reduction in weekly clean-up and maintenance time. Learn how ENDURO can help you save, too. Write today.



REPUBLIC ROLL-OVER BOXES SPEED HANDLING, reduce loss, cut costs. The Climalene Company, Chicago, uses Republic Roll-Over Boxes to store chemicals not needed immediately in production. Offset channels under the boxes permit tiering without obstruction at the top of the box. Republic Roll-Over Boxes are designed for use with trucks having a revolving-fork carriage, permitting the operator to pick up a box, roll it over, and dump the contents quickly and easily. Call your Republic Materials Handling Representative, or send coupon.



REPUBLIC WEDGE-LOCK STEEL SHELVING handles the heavyweights. Capable of exceptionally high stacking. Patented Wedge-Lock construction means that the heavier the load, the tighter the grip. Wedge-Lock includes all three prime essentials of good shelving: (1) a post that will not buckle, (2) a reinforced shelf that will not sag, (3) and a concealed sway-proof joint. Unlimited shelf arrangements. Send coupon for facts.

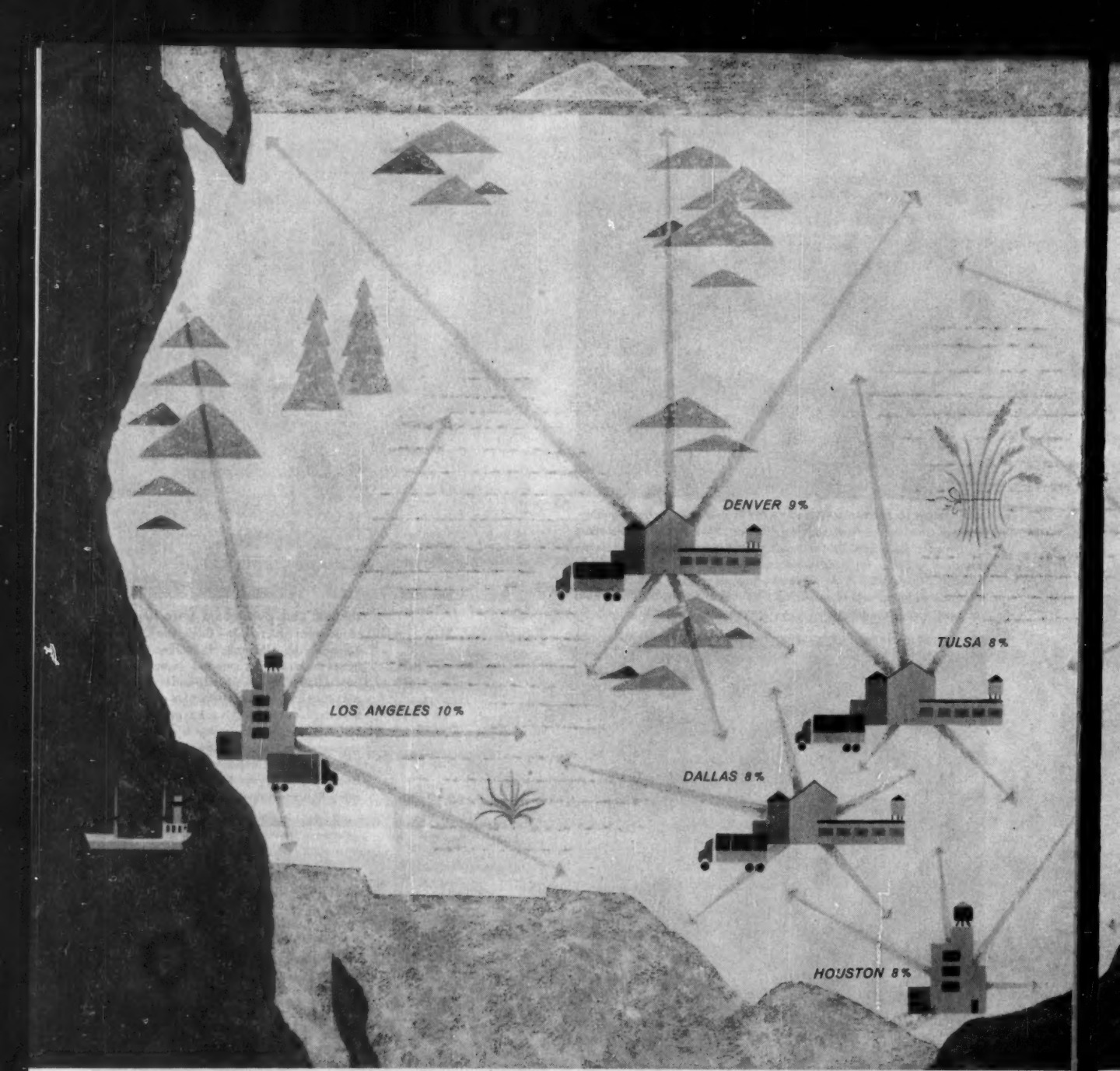
REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
DEPT. CE-6014
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send additional information on the following:
- ☐ Republic ELECTRUNITE "Dekoron-Coated" E.M.T.
- ☐ Republic ENDURO Stainless Steel
- ☐ Republic Roll-Over Boxes ☐ Wedge-Lock Shelving

Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____



NEW SAVINGS ON

Look at the map to see how much *less* you pay!

Worthington has reduced the cost of SESC pumps by spanning the nation with *new regional assembly depots.* In addition to the primary depot in East Orange, (N.J.), others have been established in Cleveland, Atlanta, St. Louis, Houston and Los Angeles. Worthington can now pass along savings to you in three ways. One, on the price: as much as 10% depending upon your location. Two, on time—because your order can be processed and shipped in a matter of hours. Three, on parts service—because each of the assembly depots maintains a stock of spare parts.

In addition to assembly points, Worthington also maintains stocks of completely built pumps in Buffalo, Chicago, Denver, New Orleans, Dallas and Tulsa.

But there are other reasons why SESC (standard end



WORTHINGTON PUMPS

suction centrifugal) is far and away your best pump buy. Standardization gives you a high degree of interchangeability. Pumps may be all iron, all bronze, standard fitted, or Worthite*. 120 different sizes, with open or closed impellers are available with capacities up to 2700 GPM and heads to 550 Ft. Conventionally packed boxes or mechanical seals are optional in all pumps, and conversions from packed boxes to seals may be made on units in the field. All in all there are 70,480 modifications of the SESC pump to choose from—the broadest combination the pump industry has to offer.

SESC pumps also give you these benefits of standardization. You can cut your spare parts inventory by 50% because only four bearing frame sizes are used for the entire 120-pump line, and all pump parts are interchangeable. This means reduced downtime if repair or conversion is made. Finally, one basic design for the complete line simplifies maintenance and lowers overall operating costs.

Take advantage of the new low costs—the speeded delivery—the many outstanding features of the Worthington SESC line now. For detailed information, write for Bulletin W-300-B48. Worthington Corporation, Section 20-3, Harrison, New Jersey. In Canada: Worthington, Ltd., Brantford, Ontario.

*Worthite is a high nickel, high-chromium, low-carbon alloy steel. Trademark Reg. U. S. Pat. Off.

WORTHINGTON



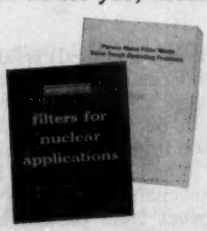
Purolator can do with
POROUS METAL FILTER MEDIA

Purolator can do just about anything with porous metal as filter media to meet the exact requirements of the job to be done. The qualities listed above are those demanded by the use for which that typical filter was designed.

Purolator's staff of Q and L cleared filtration engineers can use porous metal – or any other filtration media – to solve the newest and toughest filtration problems. This staff keeps complete control of its designs right through the manufacturing process, because Purolator has full production facilities in one plant.

Because Purolator can construct the filter element, and its housing, of any known metal or alloy, the widest possible range of operating conditions can be handled.

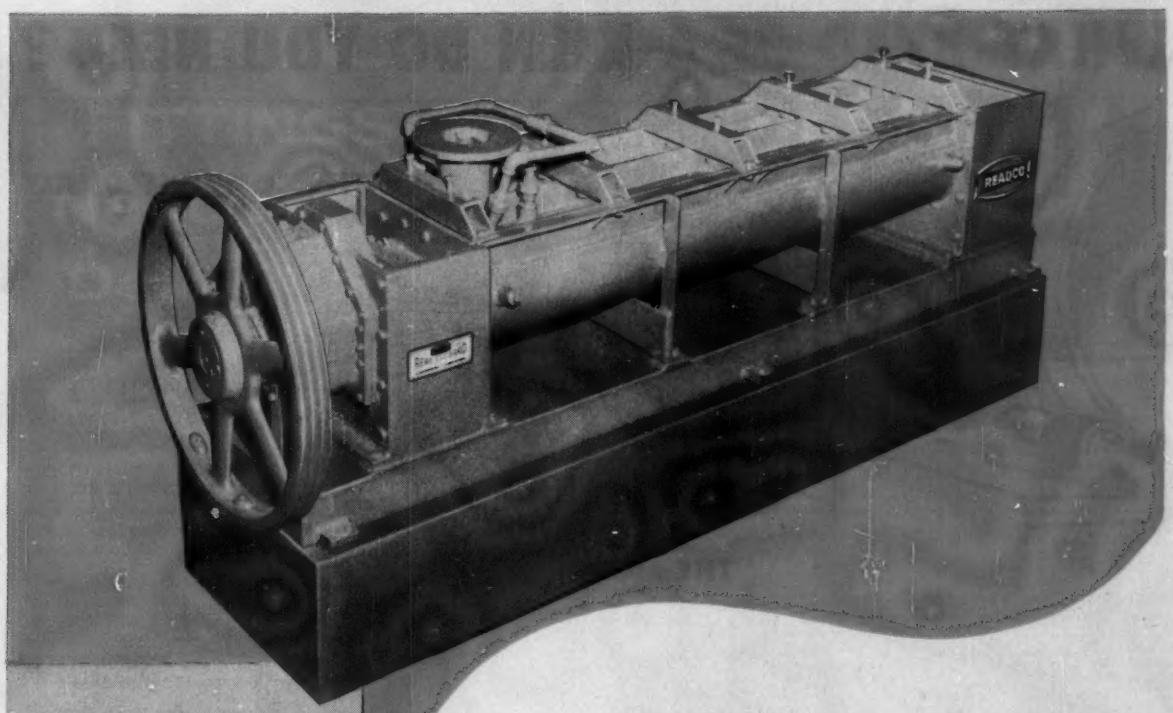
These two booklets tell you Purolator's basic story. To find out what Purolator can do for you, describe your filtration requirements to Jules Kovacs, Vice President in charge of Research and development and Product Application. If you have a really tough problem, include engineering drawings.

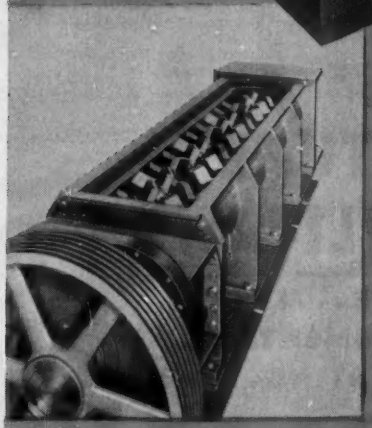


Filtration For Every Known Fluid **PUROLATOR**

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA





READCO

3 CUBIC FEET A MINUTE

Perfectly Mixed!

Speed production, lower costs...automatically with Readco Continuous Double Arm Mixers

You can step up production and reduce costs of processing dense and viscous materials with this rugged Readco mixer. Built for continuous, automatic operation, it will turn out ½ to 3 cubic feet per minute . . . in a completely homogeneous mix.

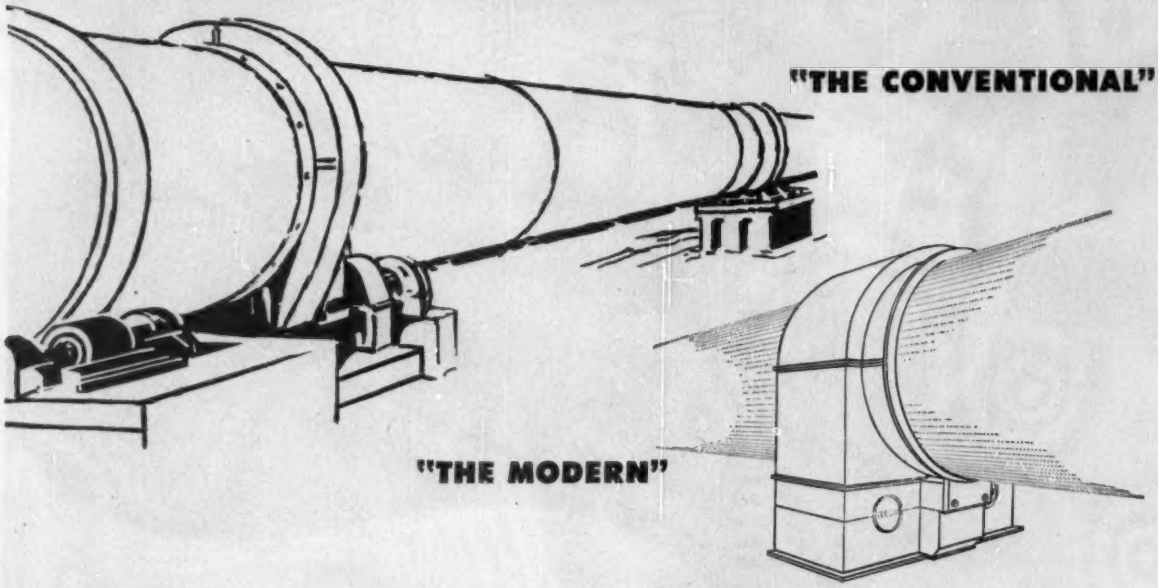
Overlapping action of mixing paddles fully disperses ingredients while moving them along to discharge. Temperature controlling jackets for heating and cooling are standard equipment.

For further information on Readco mixing equipment, see Chemical Engineering Catalog pages 1483 to 1490.

Whatever the mixing job: a READCO mixer!

READ STANDARD
York, Pennsylvania
A Division of
Capitol Products Corporation

WHAT KIND OF A KILN DO YOU NEED?



VULCAN of WILKES-BARRE WILL DESIGN & MANUFACTURE ANY TYPE • FOR ANY APPLICATION

CEMENT (WET-DRY)... COKE... LIME...
CALCINED DOLOMITE... PIGMENTS...
NODULIZING... AGGLOMERATING... SINTERING

Plus Kilns for many other related chemical and metallurgical processes. VULCAN: the oldest name in Rotary Kilns, is ready to take care of your every need. Top-flight engineers are constantly searching for new developments in this field. This is reflected by recent patent applications evolving the "New Concept in Rotary Kilns". Always highest quality material fabricated in a modern plant by skilled craftsmen . . . Every department co-ordinated for fast follow-through.

VULCAN designs, engineers, and manufactures Rotary Kilns . . . and items listed below. If you need a Rotary Kiln that is unusual in size . . . type . . . application . . . contact the "kiln specialists" . . . Contact VULCAN of Wilkes-Barre. Write or call today. Estimates, constructive suggestions and preliminary drawings will be furnished (as far as possible) without obligation.

ANY INFORMATION ON ITEMS LISTED BELOW WILL BE SENT YOU IMMEDIATELY.

Rotary Kilns, Coolers • Improved Vertical Lime Kilns • Cast Steel Sheaves, Gears
Rotary Dryers • Automatic Quick Lime Hydrators • Steel Plate Fabrications
Rotary Retorts, Calciners, etc. • Briquetting Equipment • Heavy Duty Sugar Mills

VULCAN IRON WORKS

WILKES-BARRE PENNSYLVANIA

"THE OLDEST NAME IN ROTARY KILNS"

ESTABLISHED 1849 • CABLE ADDRESS: VULWORKS

SPECIAL FITTINGS Need *NOT* Delay You



Entire interior and exterior surfaces of special stainless elbows for nuclear power plant are inspected with dye penetrant in search of microscopic surface imperfections. Elbows are 16" O.D. with 102° included angle and long tangent on one end.

Midwest Can Make *and* Deliver

An exclusive and flexible manufacturing process enables us to make welding fittings of any material available in plate that can be worked and welded. As plate is more readily available than pipe, in special materials and thicknesses, deliveries are much better.

Elbows with special included angles, special tangents, special wall thicknesses and of special materials are easily and promptly made. Closer tolerances are inherent in the Midwest process. Quality control always exceeds code requirements . . . can be as comprehensive as you need.

Whether or not you use specials, Midwest Welding Fittings will do a better job for you. Consult your distributor, or write us for new Bulletin 5801.

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Mo. (P. O. Box 433)

PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

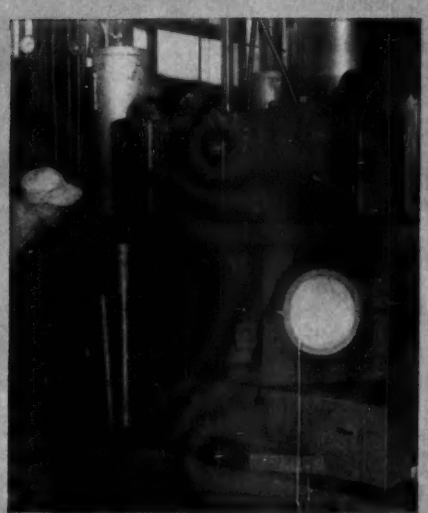
SALES OFFICES:

Asheville, (Box 446, Skyland, N. C.) • Atlanta 9—72 11th St., N. E.
Boston 27—426 First St. • Chicago 3—79 West Monroe St.
Cleveland 14—616 St. Clair Ave. • Houston 2—1213 Capitol Ave.
Los Angeles 33—520 Anderson St. • Miami 34—2103 Le Jeune Rd.
New York 7—50 Church St. • Pittsburgh 19, Pa.—437 Grant St.
San Francisco 11—420 Market St.
St. Louis 4, Mo.—1452 South Second St.
Tulsa—1640 E. 21st St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES



Note the exceptionally long tangent on one end of this 36" O.D. 90° short radius elbow made of special carbon steel. Similar tangent could have been provided on other end if required.



18" O.D. x 1¼" wall 90° elbows (2¼% chrome ½% moly) being sized in compression by totally enclosing dies. The exceptional dimensional accuracy that results is possible only with the Midwest process.

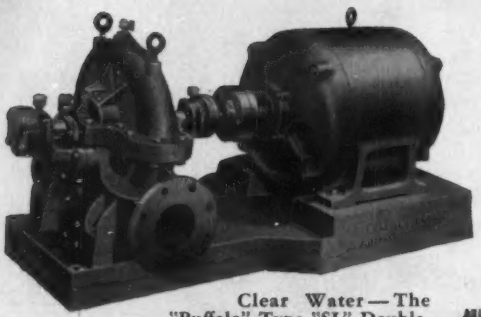


Interior surface of 30" O.D. stainless steel welding elbow for liquid sodium nuclear system required a finish of 125 micro-inches or better.

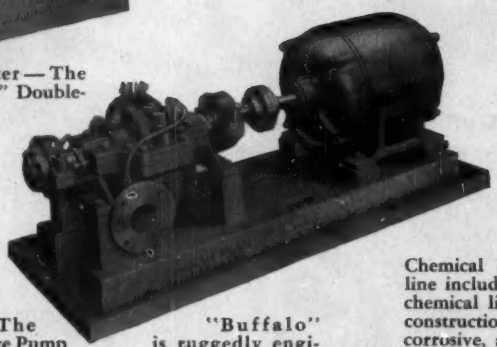
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MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN and REDUCE COSTS

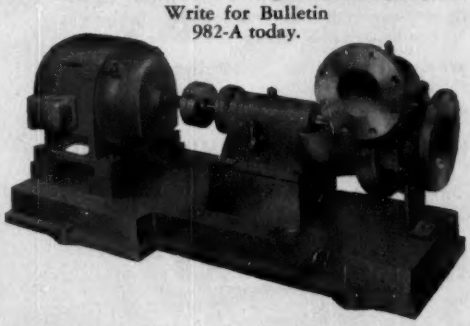


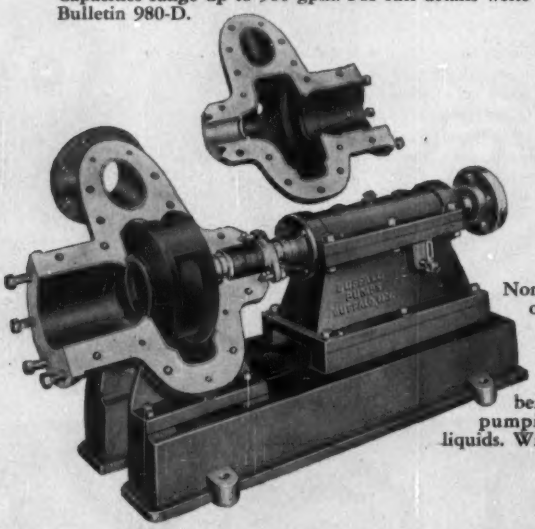
Clear Water — The "Buffalo" Type "SL" Double-Suction Pump is recognized for its highly efficient clear water service throughout industry. Capacities from 10 to 14,000 gpm. Write for Bulletin 955-R.



High Pressure — The "Buffalo" Type "RR" Multi-Stage Pump is ruggedly engineered to deliver peak efficiency on boiler feed and other clear water applications against heads as high as 1500 feet. Capacities range up to 900 gpm. For full details write for Bulletin 980-D.

Chemical Liquids — The complete "Buffalo" line includes ten specially designed pumps for chemical liquids. Available in several types of construction for handling a wide variety of corrosive, abrasive or high-consistency liquids. Write for Bulletin 982-A today.





Non-Clogging — "Buffalo" Diagonally Split-Shell Pumps are designed for moving high-consistency liquids, with down-time reduced to an absolute minimum. A number of models are available for pumping abrasive and corrosive liquids. Write for Bulletin 953-K.

WHATEVER YOUR LIQUID-MOVING PROBLEM, THERE'S PROBABLY A "BUFFALO" PUMP TO SOLVE IT!

And the fact that "Buffalo" builds a *complete line* of pumps — a type, size and capacity to fit almost every liquid-moving need — can save you money right from the start. It means you never need to pay for "more pump" than you actually require.

You'll find a "Buffalo" Pump to match your exact requirements, with complete assurance of the utmost efficiency, dependability, ease of maintenance and long-range economy. Just contact your nearest "Buffalo" engineering representative, or write us direct. We'll be glad to recommend the pump that's best-suited to your needs.

THE COMPLETE "BUFFALO" LINE ALSO INCLUDES: Heat Transfer Pumps, Close-Coupled Pumps, Sump Pumps and Raw Sewage Pumps. Special alloys available in all models.

Engineered into every "Buffalo" Pump is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

BUFFALO PUMPS
DIVISION OF BUFFALO FORGE CO.
501 Broadway • Buffalo, N. Y.
Canada Pumps Ltd., Kitchener, Ont.
Sales Representatives in All Principal Cities
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Claymont's 160-inch plate mill in action. Fully integrated steel producing facilities and a complete range of fabricating equipment make Claymont a reliable source of quality steel plate and plate products for industry.

Photo by d'Arazien

CLAYMONT STEEL PLATES

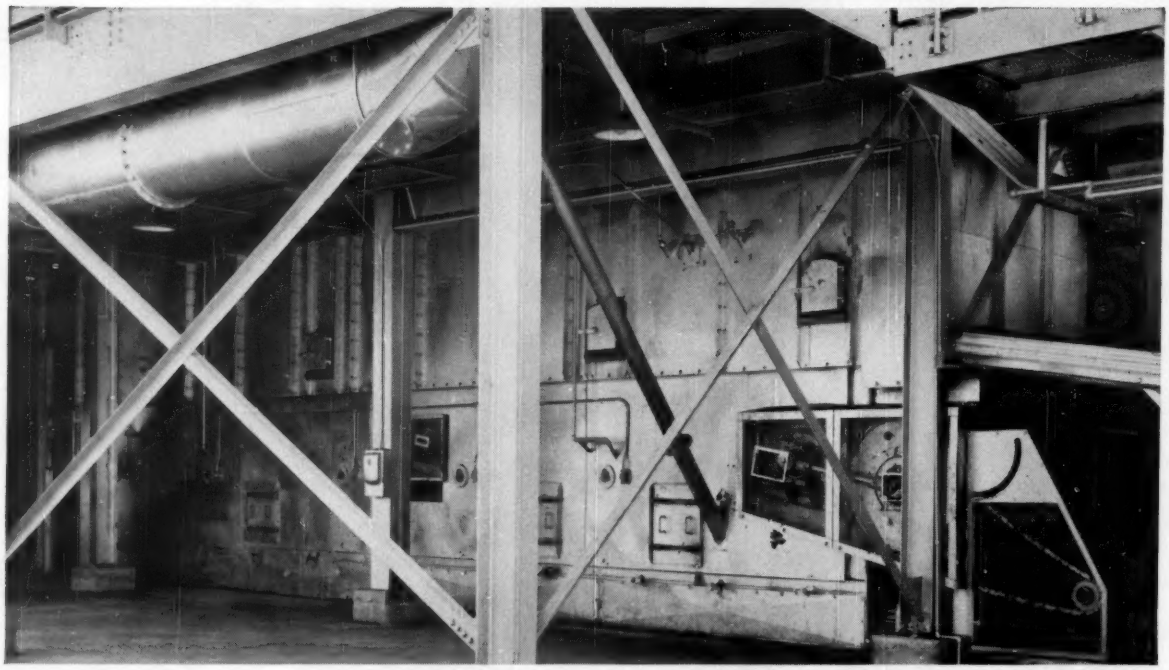
CF&I

CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products Large Diameter Welded Steel Pipe

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION

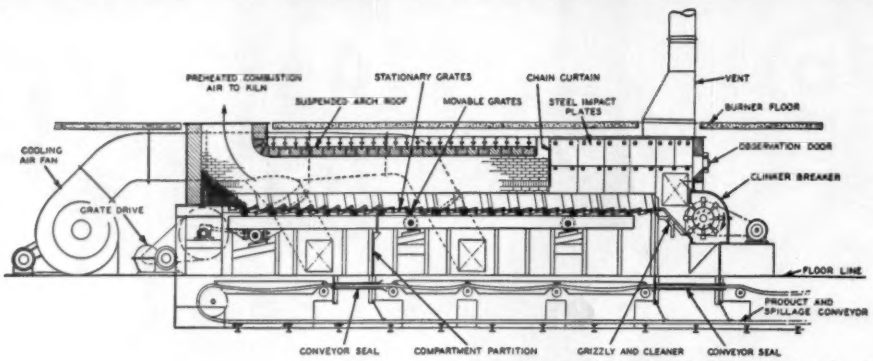
Plant at Claymont, Delaware • Sales Offices in all Key Cities

5746



Side View from feed end of a 7' x 44' Horizontal-Grate Cooler, designed for cooling 4,000 barrels of Portland cement clinker per day, showing crank type grate drive.

New Fuller HORIZONTAL-Grate Cooler



Cross-section drawing showing construction and arrangement of a typical Horizontal-Grate Cooler with clinker breaker.

Compact . . . Economical . . . Fast-cooling. Already proven in use, the compact, efficient design of Fuller's new Horizontal-Grate Cooler promises savings for many plants. It's an ideal choice where headroom is at a minimum . . . where a short, compact unit is desired.

Like the famous Fuller Inclined-Grate Cooler, the new Horizontal-Grate type is meeting with wide acceptance. One of the new units, already in operation, is shown above.

A Fuller Horizontal-Grate Cooler or an Inclined-Grate unit is the right answer to your cooling needs. Fuller coolers are used for a wide range of materials including lime, dolomite, cement clinker, iron nodules, phosphate nodules, sinter, ores, and others. Fuller sales engineers will be glad to discuss your cooling problems and make recommendations for your plant—without obligation, of course.

Features of the Fuller HORIZONTAL-Grate Cooler

- Requires a minimum of headroom
- Short length if necessary
- Better secondary air temperature control
- Less refractories
- Less installation time
- More rapid clinker distribution
- More uniform bed thickness

FULLER COMPANY
GENERAL AMERICAN
TRADE MARK

Fuller
pioneers in harnessing AIR

FULLER COMPANY
154 Bridge St., Catasauqua, Pa.
SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION

Birmingham • Chicago • Kansas City • Los Angeles • San Francisco • Seattle

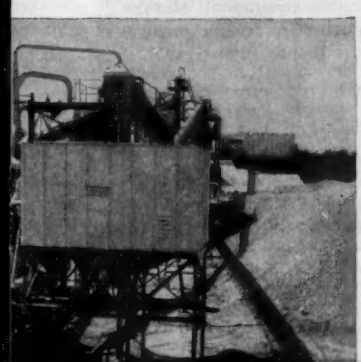
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"See Chemical Engineering Catalog for details and specifications".



Walkway to efficient dust control

Pangborn Cloth Bag Dust Collector on the job. This is just one of Pangborn's complete line of wet and dry dust collectors.



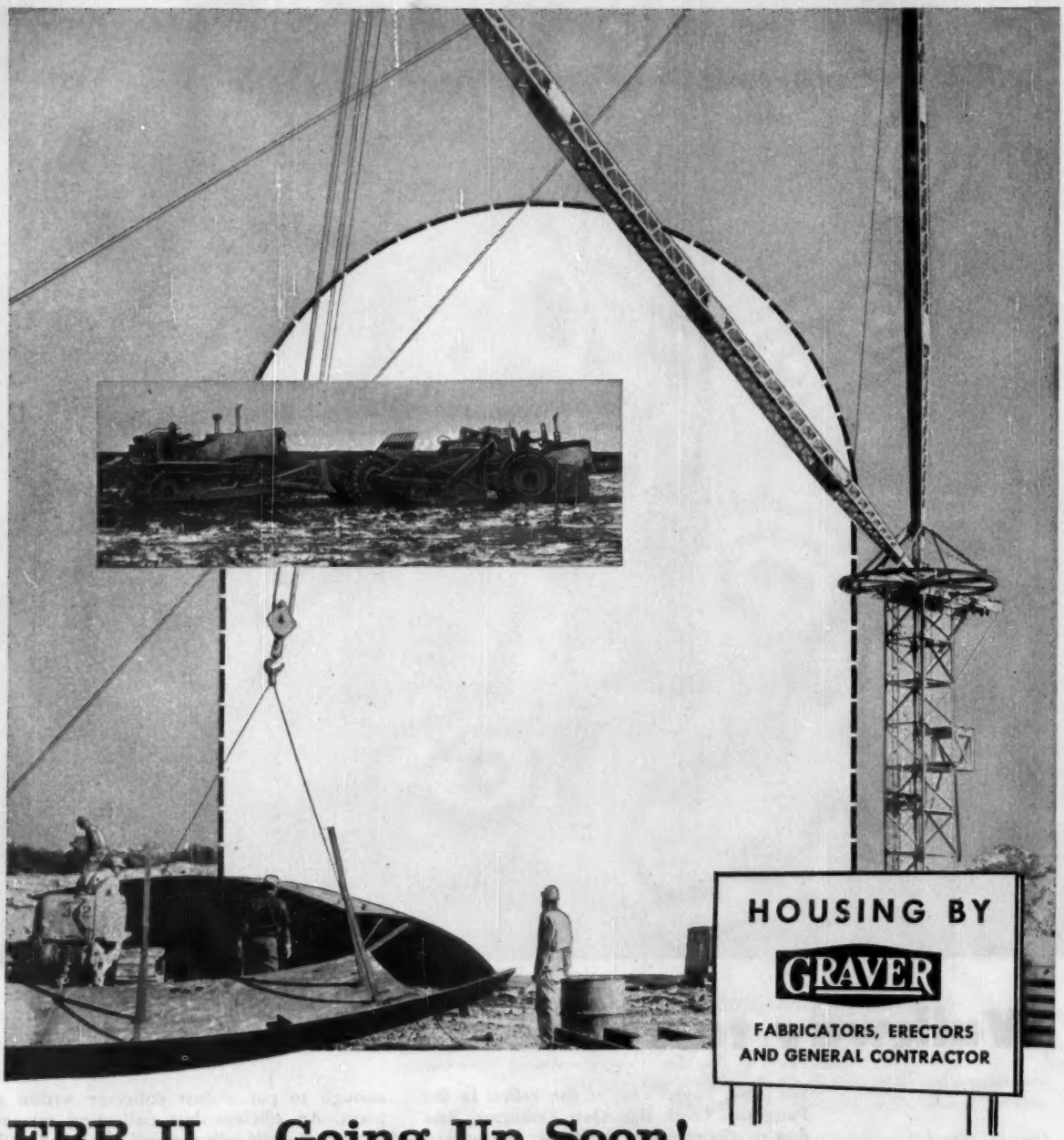
See those bags? They're the *collect* in the Pangborn Cloth Bag Dust Collector. And they're efficient! The cloth filter has proved the most practical method for collecting finely divided dry dusts. But Pangborn goes a step further. Pangborn engineering has not only adapted this design to increase its collecting effectiveness but has simplified its construction. This means you save money. The Pangborn Cloth Bag Collector offers maximum efficiency, yet is economical to buy, install and operate.

Pangborn engineering is important to every dust-producing plant, regardless of the kind of collector needed. It is not enough to put a dust collector within a plant. An efficient dust collecting system must be *scientifically* planned, designed and constructed to handle effectively a specific dust problem. This thinking is incorporated into every Pangborn proposal.

The Pangborn Engineer in your area will be glad to go to work for you. He is a dust expert *and will discuss your individual problem at no obligation. And, for more information, write for Bulletin 922 to:* Pangborn Corp., *2600 Pangborn Blvd., Hagerstown, Md. Manufacturers of Dust Control and Blast Cleaning Equipment.*



Pangborn CONTROLS DUST



EBR II...Going Up Soon!

Ground breaking equipment is busily engaged in the construction of Argonne's new Experimental Breeder Reactor II near Idaho Falls, Idaho, with Graver as General Contractor. Scheduled for completion in 1958, EBR II will be housed in a giant pressure vessel 139′ high by 80′ wide fabricated by Graver from 1″ carbon steel. A 200,000 gallon water tank, also fabricated by Graver, is an integral part of the structure.

Graver fabrication and erection experience with atomic energy installations goes back to the mid-thirties when the first experiments with atom smashing were taxing the ingenuity of American scientists. Graver skills with steels and alloys for more than a century have been called upon regularly for process equipment, storage vessels and containment housing for atomic energy. It will pay to prepare for the future with Graver.

GRAVER®

Building for the Future on a Century of Craftsmanship in Steels and Alloys

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

New York • Philadelphia • Edge Moor, Delaware • Pittsburgh
Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston
New Orleans • Los Angeles • Fontana, California • San Francisco

End Liquid Metering Problems with a Lapp PULSAFEEDER CONTROLLED-VOLUME CHEMICAL PUMP

NO LEAKAGE
NO PRIME LOSS
NO CONTAMINATION
NO STUFFING BOX



WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 3602 Poplar St., Leroy, N. Y.*

● Precise metering, pumping, proportioning and feeding of hard-to-handle chemicals is the specialty of the Lapp PULSAFEEDER. Designed for accurate handling of corrosive and non-corrosive liquids, it is a combination piston-diaphragm pump . . . providing positive displacement with *no stuffing box*. Leakage or contamination of the liquid being pumped is prevented by a hydraulically balanced diaphragm isolating the liquid from the pump's drive mechanism. All pump parts contacting liquid are of special corrosion-resistant materials. Pumping speed is constant; variable flow results from variation in piston-stroke length, controlled manually by hand-wheel, or, in auto-pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

Lapp

Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.



"Lixator" Improvements Make Brine Production More Efficient

Widely used throughout industry, Lixators are automatic rock-salt dissolvers developed exclusively by International Salt Company. They produce high-quality, fully saturated, self-filtered brine . . . and virtually eliminate the work and expense of storing, handling and using dry salt.

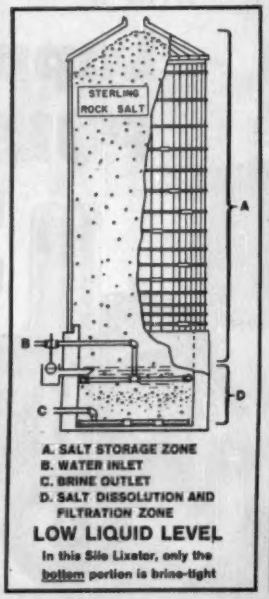
Excellent as this brine-making equipment is, International is constantly working to *improve* Lixator designs. From time to time, we also introduce special new Lixator attachments. Here are some improvements and attachments that can make production of Lixate brine more efficient and economical in your plant.

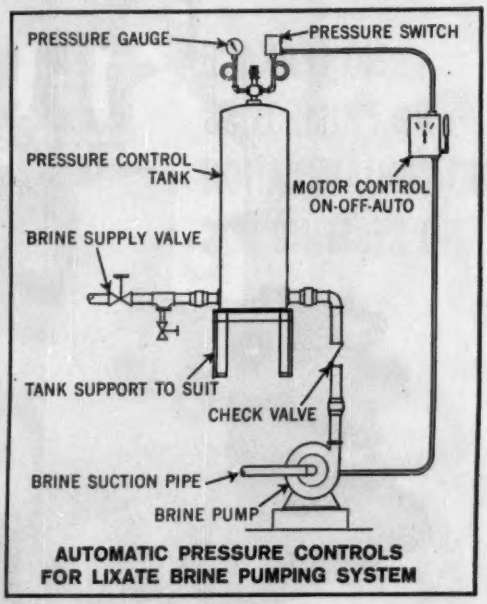
Low liquid level—a basic design feature that provides great savings by eliminating the need for deep salt-dissolving tanks. For example, it is possible to convert an old silo, dry-salt storage bin or unused room into a first-rate Storage or Silo Lixator simply by making the lowest portion into a waterproof salt-dissolving and brine-storage tank. The upper portion need *not* be waterproofed or made brine-tight.

A common method of waterproofing is to line the floor and bottom portion of the walls with concrete. Lixate brine is made in this lower tank portion, with dry salt occupying the space above the liquid level.

Electrode controls. To regulate the liquid level in a Lixator, electrode controls are often used. This is an excellent alternative to the standard float controls in many Lixator installations.

Two electrodes of different length are protected in a length of pipe, then immersed in the Lixator. Whenever the liquid level falls below the lower electrode, the electric circuit is broken, a relay opens to close a load contact, and the water valve is opened. When the liquid level rises to the higher electrode, the circuit is closed, and the relay closes to shut the valve. In this way the brine level is maintained between the desired limits in the Lixator—continuously and automatically.





Pressure controls . . . for brine systems. International has introduced the technique of automatically starting and stopping Lixate brine pumps by pressure switches. If a valve is opened anywhere in the brine distribution piping, brine flows and brine line pressure drops slightly. This, in turn, activates a switch, starting the pump, which withdraws brine from the Lixator. Everything is automatic. The operator only opens and closes a brine valve at the point of use.



Introduction of brine-metering devices. In cooperation with leading meter manufacturers, International has pioneered in the application of highly accurate and specialized meters for brine. Among the advantages of using these meters with Lixators is precise *salt* measurement, since every gallon of Lixate brine contains exactly 2.65 lbs. of salt. Also, automatic shut-off metering devices allow you to preset the amount of brine you want. Flow will stop when this amount has been measured out.

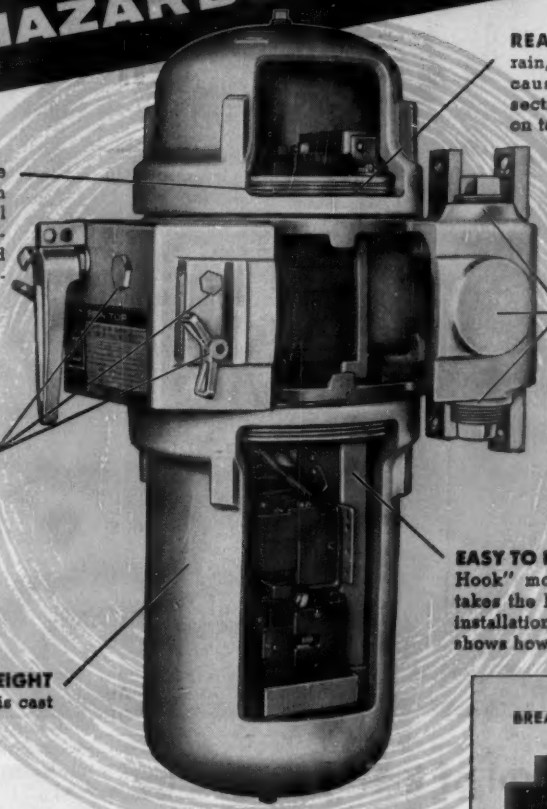
In many other ways, brine meters and other Lixator attachments can boost brine-making and brine-using efficiency. To find out how you can benefit from such devices, contact International. One of our experienced sales engineers will gladly explain about brine-density and brine-flow regulators, piping layouts, continuous brine-dilution devices, etc. He can also recommend the type and size of Sterling Salt best suited to your needs.

INTERNATIONAL SALT CO., SCRANTON, PA.
Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn.; and Richmond, Va.

Service and research are the extras in **STERLING SALT**
PRODUCT OF INTERNATIONAL SALT COMPANY, INC.

Square D announces...

NEW SPIN TOP ENCLOSURE FOR HAZARDOUS LOCATIONS



REAL PROTECTION against rain, dust, dirt and weather because male threads on collar section engage female threads on tank.

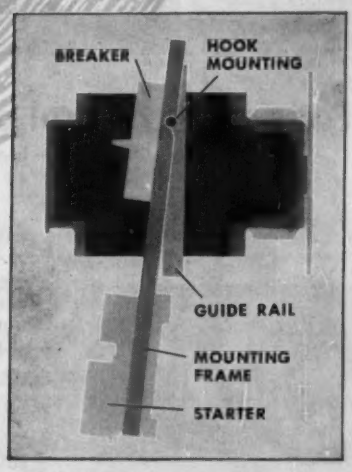
DAMAGE-RESISTING Acme thread. If you've struggled with "banged-up" threads, you'll appreciate this feature. It's always a breeze to put on and take off tanks for installation, inspection or maintenance.

INCREASED WIRING SPACE and through-feed conduit entrances for horizontal tap-offs.

EASY TO ADD pushbuttons or selector switches with easy-to-buy, easy-to-use "off-the-shelf" parts kits.

EASY TO INSTALL • "Slide and Hook" mounting arrangement takes the hard work out of the installation job. Diagram below shows how.

STRONG and LIGHTWEIGHT The complete enclosure is cast aluminum.



SLIDE and HOOK MOUNTING

4 SIZES FOR STARTERS SIZE 0 THROUGH 5

CLASS I, GROUP C and D • CLASS II, GROUP E, F, and G

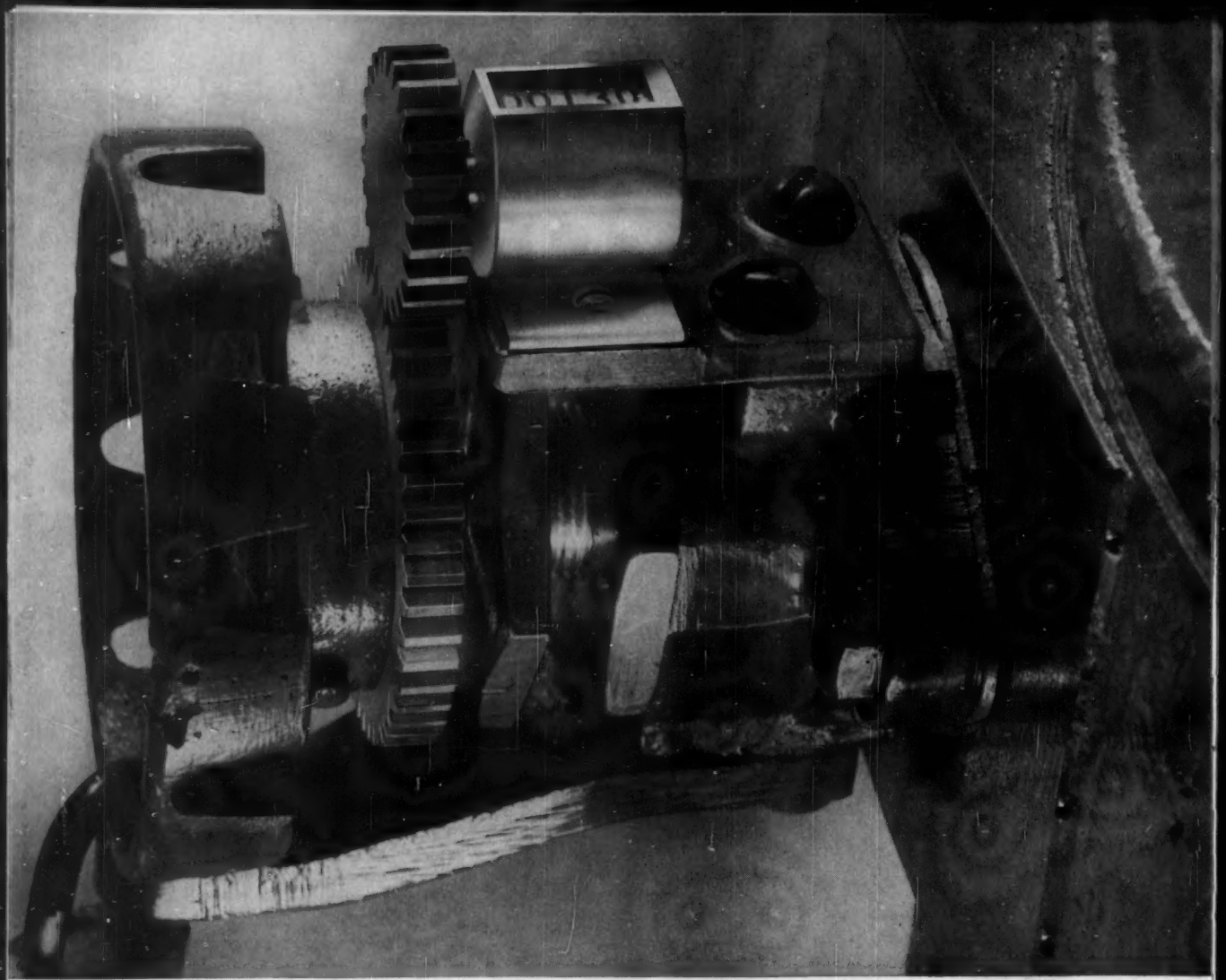
The new **SPIN TOP** enclosure is available from your Square D Distributor in three ways—complete device, enclosure only, or components only...for reversing and non-reversing across-the-line starters and combination starters. And for combination and non-combination two-speed starters.

Write FOR BULLETIN 9990

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

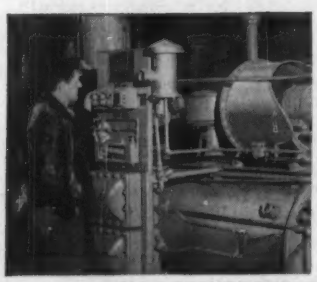
SQUARE D COMPANY



Air-Gas Ratio Valve

For precise control of inert gas quality . . .

Come to Kemp



Heyden Chemical saves over $500 a month with CO_2 supplied by this Kemp Inert Gas Generator. Kemp units are on the job in leading plants everywhere, cutting costs and providing greater safety.

Only Kemp Inert Gas Generators have the famous Kemp Industrial Carburetor at the vital heart of the process. This carburetor, developed and patented by Kemp, gives exacting control to the generation of inert gasses. From mere pilot burner operation to full generator capacity, inert gas analysis is exact and constant, regardless of demands on the system.

Kemp-produced inerts are low-cost inerts. You can use them liberally, at a fraction of the cost of bottled gasses, for purging, blanketing, controlling reactions, agitation, or any of a hundred applications. You get better quality control and increased safety at the lowest possible operational cost.



For round-the-clock inert production with minimum maintenance, depend on Kemp Inert Gas Generators. Your Kemp Representative will suggest the proper model to fill your needs. Or write us direct for Bulletin I-10. The C. M. Kemp Mfg. Co., 405 E. Oliver St., Baltimore 2, Md.



Kemp Convection Dryers



Kemp Immersion Melting Pots

KEMP OF BALTIMORE



Kemp Industrial Carburetors



Kemp Oriad Dryers

Alloy Steel Products Company

sets up new Division to specialize in

NUCLEAR VALVES

Complete separate facilities provide prime source of supply for expanding nuclear industry

With over 29 years of specialized experience as a leading producer of high alloy valves for the process and related industries, it was natural for Alloy Steel Products Co. to be called upon to help with the valve problems of the new and progressive nuclear industry. Alloy Steel Products Co. has contributed to the development and production of various types of valves for critical applications in nuclear reactor plants.

With the need for nuclear valves increasing so rapidly, Alloy Steel Products Co. recognized that the only right way to serve the nuclear industry was to set up a complete and separate Nuclear Division with extensive facilities for design, engineering, manufacturing, testing, and sale of the special types of valves required. Today, with a completely new plant, an engineering staff selected for technical background and experience in the nuclear field, and some of its nuclear valves actually in production, the Nuclear Division is an accomplished fact.

The new facilities are equipped with the finest, most modern machinery. A hot test loop with circulating demineralized water which duplicates production pressures and temperatures up to 2500 psi and 650° F will be available for engineering and production tests. Facilities are provided for cleaning valves and castings to nuclear cleanliness standards.

The Aloyco Nuclear Division is designed to produce low pressure valves up to the 24-inch size, and high pressure valves up to the 18-inch size. Aloyco Nuclear valves are designed for practically any type of radioactive piping system. These include power and research reactor coolant systems, fuel processing systems, and waste disposal systems. The Nuclear Division will apply its know how and its nuclear facilities to improve the state of the art while supplying the industry's valve needs.

NOW IN PRODUCTION... Already certain nuclear valve lines are well beyond the design stage. Two complete lines of bellows sealed valves designed for highly radioactive, toxic, or explosive fluids are now in production. The Nuclear Division is prepared to quote on:

- Main coolant system check valves
- hydraulically or electrically operated main coolant system stop valves
- bellows sealed valves for highly radioactive, toxic or explosive fluids
- low pressure valves for demineralized high purity water service
- high pressure "capped" valves for throttling, isolation, drain, and instrument lines
- manually operated gate and globe valves for a myriad of auxiliary high pressure and temperature services

The Nuclear Division of Alloy Steel Products Co. invites your inquiries on the above listed and other valves for nuclear application. The engineering services of the division are available to you for consultation on your nuclear valve problems. Write us at 1301 West Elizabeth Ave., Linden, N. J. 8.4

FACTS ABOUT ALLOY STEEL PRODUCTS CO.

Although the reputation of Aloyco Valves is well known in the process industries, here are a few words about the Company for nuclear engineers.

Two facts make Alloy Steel Products' entry into the nuclear valve field a logical forward step. First, we have specialized for 29 years in one thing only—the design and manufacture of stainless steel and high alloy valves. We are the only company that does so. We built our own integrated foundry to produce a single product—pressure tight, mechanically sound stainless steel valve castings.

The same principle of putting quality first is evident in our design, engineering, machinery, control procedures and even our sales approach. Aloyco Sales Engineers handle one line only, know their business, and are equipped to be of real service to our customers.

This is a company that was built and has gone forward on the quality of its products. This is the second fact that makes our entry into the nuclear field, with its exacting requirements, so logical and inevitable. You can depend on the extremely high quality of Aloyco nuclear valves.

ALLOY STEEL PRODUCTS COMPANY

NUCLEAR DIVISION

Linden, New Jersey



Simplicity in steam traps can effect big savings in parts inventory and maintenance time

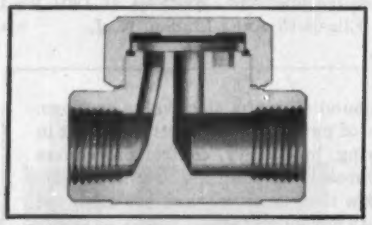
by John W. Ritter, Test Engineer
SARCO Company, Inc.

The function of all steam traps is to release condensate and prevent steam loss. However, the method of trapping can make a great difference in cost and effectiveness.

In the Sarco Thermo-Dynamic Steam Trap, the method is fundamental. Air or condensate entering the trap must flow from the inlet tube, radially across the underside of the disc valve, to the outlet. The space between the inlet tube and the disc forms a nozzle in which the static pressure energy of the incoming fluid is partly changed to velocity across the underside of the disc, with a resultant *decrease* in pressure. (This will be recognized, of course, as the Bernoulli Principle.) Use of this fundamental method means reliability in operation.

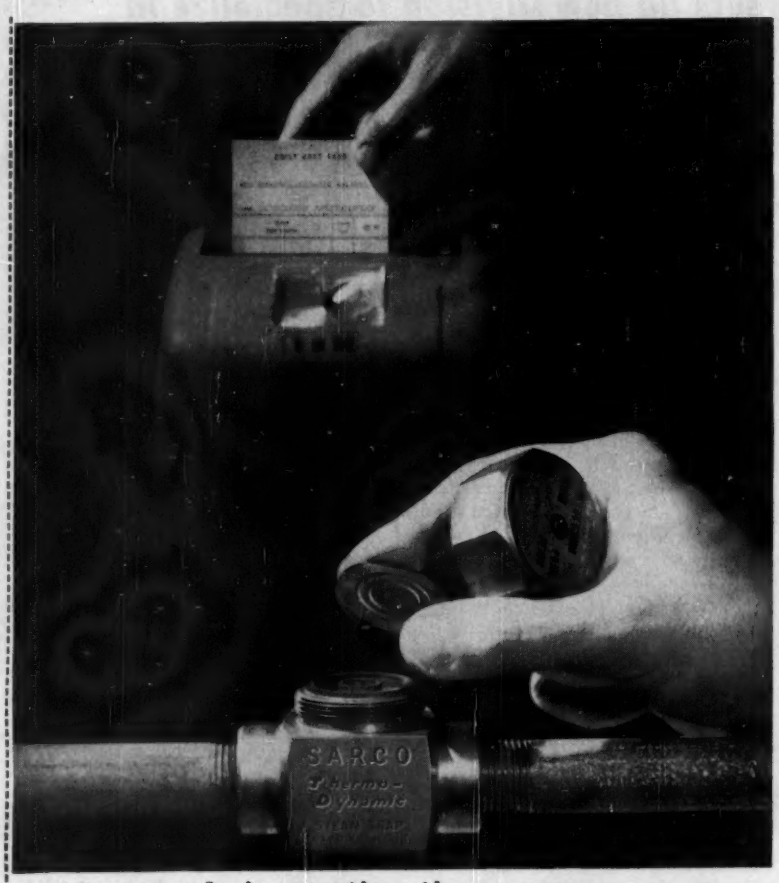
As the high velocity fluid jet strikes the side of the upper chamber, some recompression takes place, so that the pressure above the disc becomes greater than the pressure below it. The pressure reduction under the disc and the pressure recovery above it depend on the internal energy of the fluid. As the condensate above nearly approaches steam temperature, its internal energy is enough to overcome the upward force at the inlet tube and the disc snaps down in the inlet tube, which is the inlet valve seat.

Simultaneously, the disc also seals the outer ring, which isolates the space above the disc from the outlet. The disc valve is therefore held firmly against the inlet valve seat until the pressure in the control chamber is reduced by condensation. The upward force then exceeds the downward force and the disc valve opens.



This 3-part Sarco TD Steam Trap has only one moving part—the hardened, polished stainless steel disc.

No other trap uses the velocity of the fluid to operate the valve or uses the recompression of the flowing fluid to trap the valve closed and to hold it closed. When it closes, it closes tightly – no "operating steam" leaks out.



40 seconds inspection time— that's all it takes for a SARCO TD Steam Trap

Just back off the cap of a Sarco TD. Lift out its single moving part, the stainless steel disc. Wipe it off, and drop it back. No adjustment is ever required, at any load or any pressure in its range – from 10 through 600 psi.

The TD operates in any position, won't blow steam at any load. Small as a tee fitting, it can be installed in tight places. Its versatility and reliability cut cost of big replacement inventory.

Write for "Literature Kit 2A" today and get latest bulletins on the TD Steam Trap and other Sarco steam traps. Remember that Sarco can give you impartial advice on *Production Planned steam trapping* because . . .

5605-B

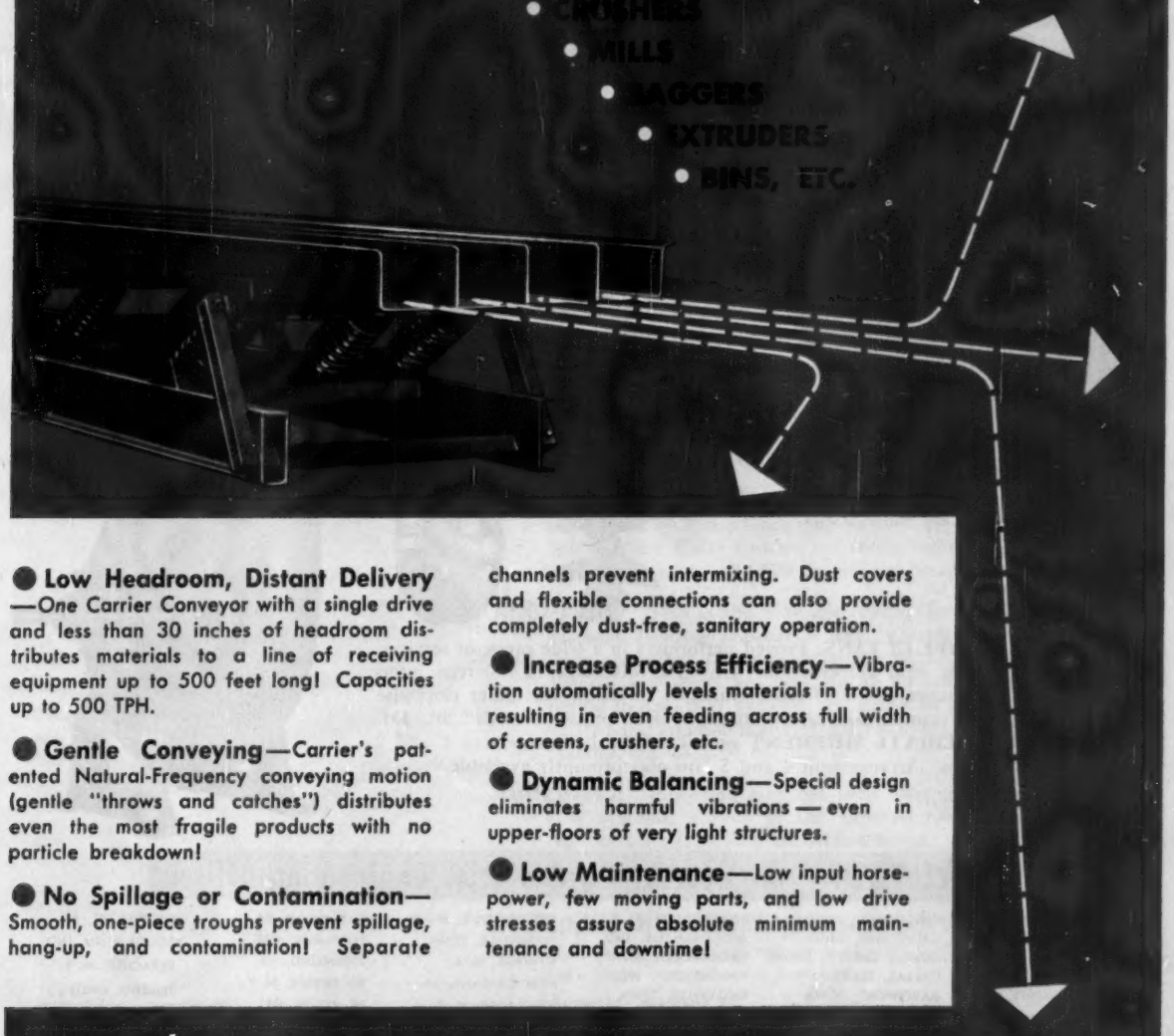
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Only Sarco makes all 5 types:
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STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

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● **Gentle Conveying**—Carrier's patented Natural-Frequency conveying motion (gentle "throws and catches") distributes even the most fragile products with no particle breakdown!

● **No Spillage or Contamination**—Smooth, one-piece troughs prevent spillage, hang-up, and contamination! Separate channels prevent intermixing. Dust covers and flexible connections can also provide completely dust-free, sanitary operation.

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● **Dynamic Balancing**—Special design eliminates harmful vibrations — even in upper-floors of very light structures.

● **Low Maintenance**—Low input horsepower, few moving parts, and low drive stresses assure absolute minimum maintenance and downtime!

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252-A North Jackson Street
Louisville 3, Kentucky

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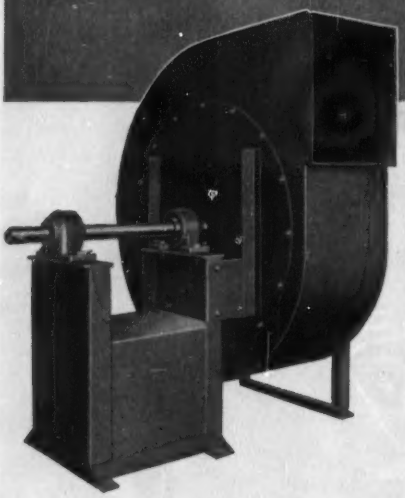
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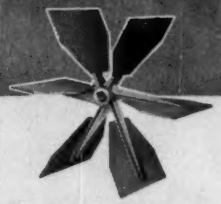
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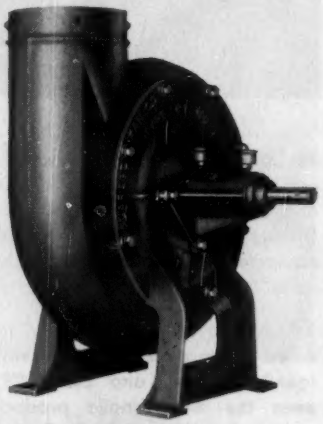




TYPE XL FANS. Distinguished by advanced design, high efficiency. Universal discharge, 3 different interchangeable wheel types available, reversible for either clockwise or counter-clockwise rotation with rim or open type wheels. Rugged, tight, fabricated steel construction. Pressures to 18" SP. **IMMEDIATE SHIPMENT** on all standard Arrangement 1 and 9 fans. Arrangement 4 and 8 fans also promptly available.







TYPE CI FANS. Proved performers in a wide range of services. Cast iron construction. Universal discharge, 2 different interchangeable wheel types available, reversible for either clockwise or counter-clockwise rotation. 6 sizes, pressures to 24" SP. **IMMEDIATE SHIPMENT** on all standard Arrangement 1 and 2 fans. Arrangement 4 and 8 fans also promptly available.

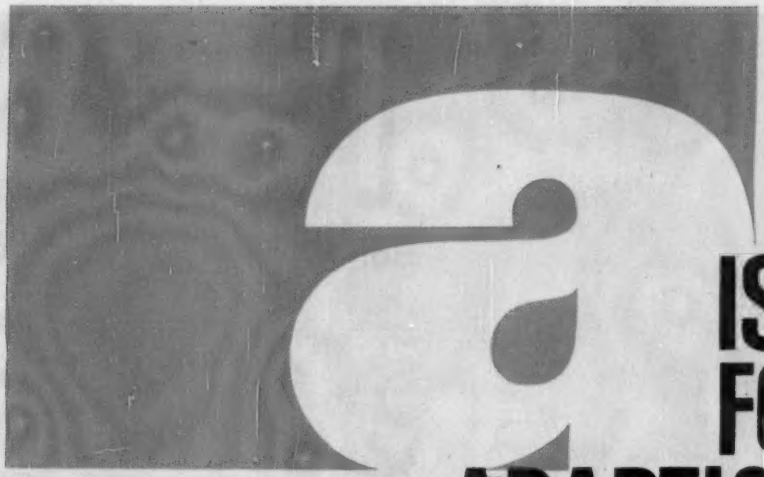
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A IS FOR ADAPTIONEERING*

(selected from the forthcoming adaptioneering dictionary)

ABRASIVES Grain-resin mixtures present an agglomeration problem. In one S-W installation, 43 Richmond/S-W Gyro-Pedestal Sifters help to maintain the uniform grain size required in the manufacture of resin-bonded abrasive wheels. Other applications include intimate blending of 350-mesh size (flour consistency) ceramic clays and feldspar mixtures.

ACETATE CELLULOSE To reduce acetate cellulose scrap, a large selection of S-W machines may be used. At a typical installation, S-W Rotary Knife Cutters cut waste material into minus 2½" ring size at a rate of 4,000 pounds per hour.

AIRO-FLOW This is the S-W designation for complete pneumatic systems. Positive pressure is usually preferred when conveying from one point to many different points, whereas negative or Pneu-Vac systems are best suited for conveying from several points to one. S-W systems are in use for all types of dry, pulverized and granular materials such as flour, feed, seeds, chemicals, plastics, etc.

ADHESIVES Powdered glue has been conveyed pneumatically by S-W systems, ground to the required mesh sizes in S-W size reduction machines, and mixed in a variety of S-W vertical mixing units. Mucilage, and ingredients such as casein are also processed in S-W unit machines.

ALUMINUM HYDROXIDE S-W Horizontal Single Ribbon Mixers with paddle agitators are used to mix finely powdered material with lump form of same material.

AMMONIUM NITRATE Conveyed from storage to mixers in S-W negative pressure systems. Although ammonium nitrate must be handled carefully because of its explosive qualities, it has been pelleted, reduced in size, and mixed in S-W equipment.

ATTRITION MILLS S-W Attrition mills grind, cut, shear, shred, pulverize, granulate, roll, crack, rub, curl, twist, hull and blend. S-W offers Single and Double Runner Mills with an endless variety of grinding plates designed by S-W engineers and cast in the modern S-W foundry.

* *Adaptioneering®. . . a unique creative engineering approach which translates the knowledge gained in one field to the solution of problems in another.*

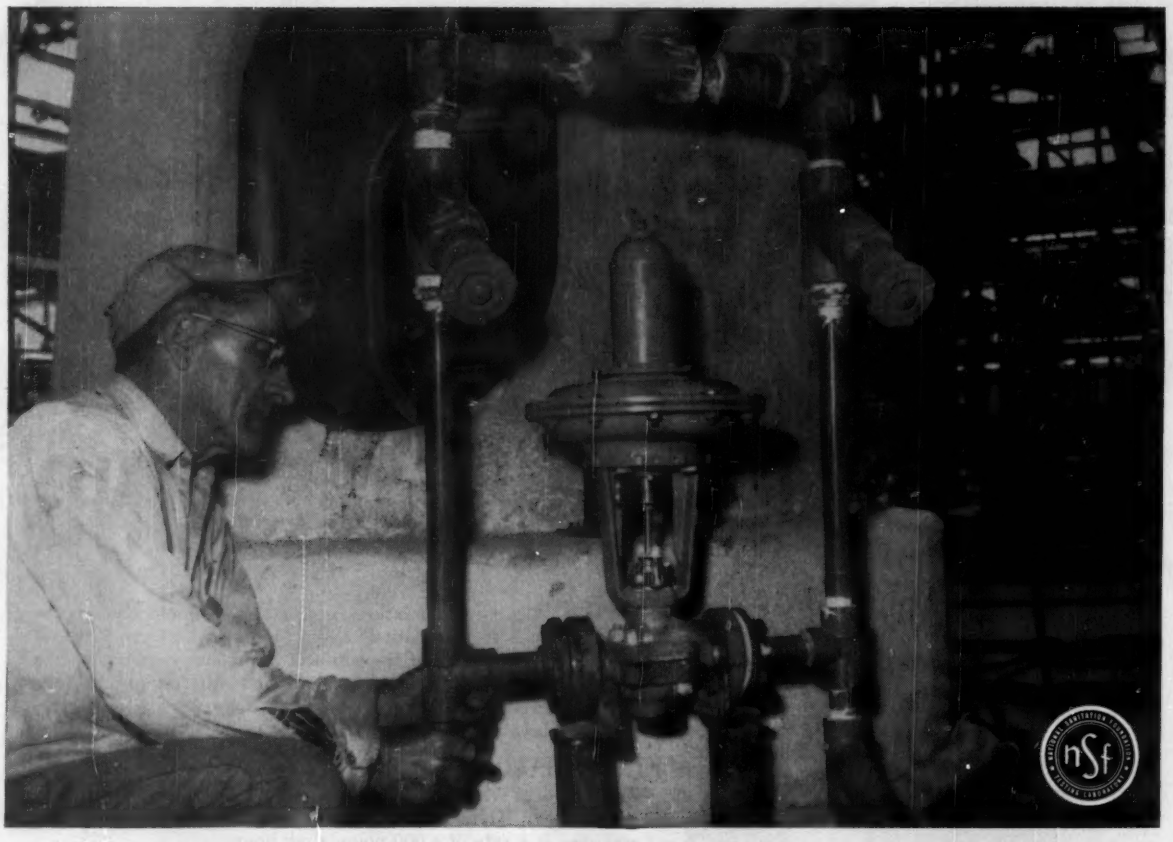
The "A" section of a dictionary of products processed in SW unit machines is available on request.

SPROUT, WALDRON & CO., INC. *Manufacturing Engineers*

MUNCY, PENNSYLVANIA, U. S. A.

SINCE 1866

Size Reduction • Size Classification • Mixing and Blending • Bulk Materials Handling • Pelleting



Texaco Chemical Plant uses acid lines of USS National* PVC Pipe

A lube oil additive plant, recently constructed by Texaco at its Port Arthur, Texas refinery, employs 750 feet of normal-impact National Polyvinyl Chloride Pipe (Schedule 80). Over 500 feet of this PVC Pipe, in diameters of 1 inch and 1½ inches, is being used to handle a variety of mineral and organic acids involved in the lubricating oil additive production process.

Other National PVC Pipe, in diameters of 2 inches, 3 inches and 4 inches, carries waste water at 120°F from the glass-lined neutralizing tank. This water also contains acids and other by-products of the process. Additional smaller diameter lines of National PVC Pipe are employed as treating tower return lines, operating at ambient at 40 to 50 psi.

Tough, rigid, acid-resistant National PVC Pipe is available in sizes up to 14" O.D. and in Schedules A, 40, 80 and 120. It comes in two types:

Normal impact – for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

High impact—for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

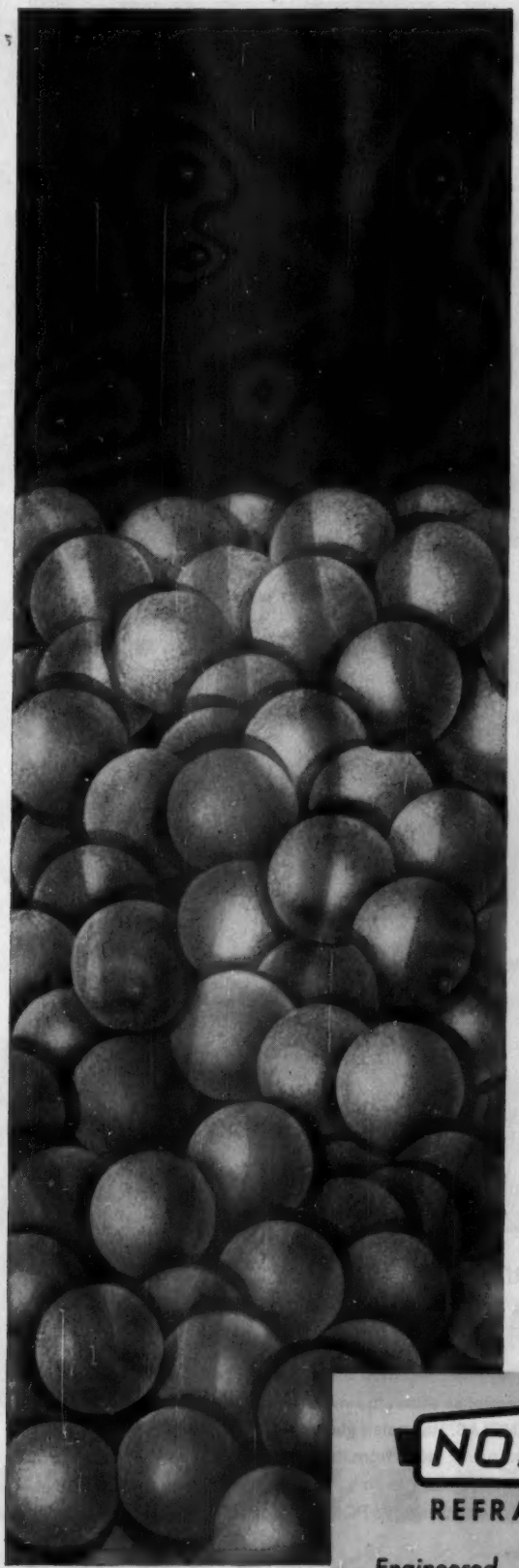
For further details, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania. Ask for Bulletin No. 24.

**Trademark*

The world's finest tubular products from the best-known name in pipe—National Tube.

National Tube Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York



ALUNDUM*
Low Surface Area Catalyst Carriers
...add speed and efficiency to many processing reactions

Crystalline in nature, Norton ALUNDUM catalyst carriers have excellent mechanical, thermal and chemical stability. The most widely used type has low surface areas of less than $1 m^2/gram$, combined with high alumina content of 77% to 92%.

Shapes and Sizes: low surface area type; spheres 3/16" to 1½" diameter; pellets ⅛" x ⅛" to ½" x ½"; rings ⅛" x ⅜" x ⅜" O.D. to 1" x 1½" x 1½" O.D.

Other Physical Properties: apparent porosity 10-50%; water absorption 3-25%; bulk density 1.90-3.15 gr/cc; volume bulk density 65-80 lbs/ft^3; crystal structure alpha alumina and mullite.

Typical Applications: processing phthalic anhydride, maleic anhydride and ethylene oxide; also in protective atmospheres and synthetic gas generation.

Suspending active catalysts effectively

In fixed bed convertors, Norton inert supports are located to suspend active catalysts at given levels, as shown in diagram. Made of dense, rugged, electrically fused materials they have great resistance to breakdown and no chemically reactive effect on the processing.



Other carriers and supports

are produced by Norton with intermediate surface areas. On request, any type may be prepared from other materials, such as CRYSTOLON* silicon carbide, MAGNORITE* fused magnesia, zirconium oxide, silica, etc. For further facts call in your Norton Refractories Engineer, or write to NORTON COMPANY, Refractories Division, 507 New Bond Street, Worcester 6, Massachusetts.

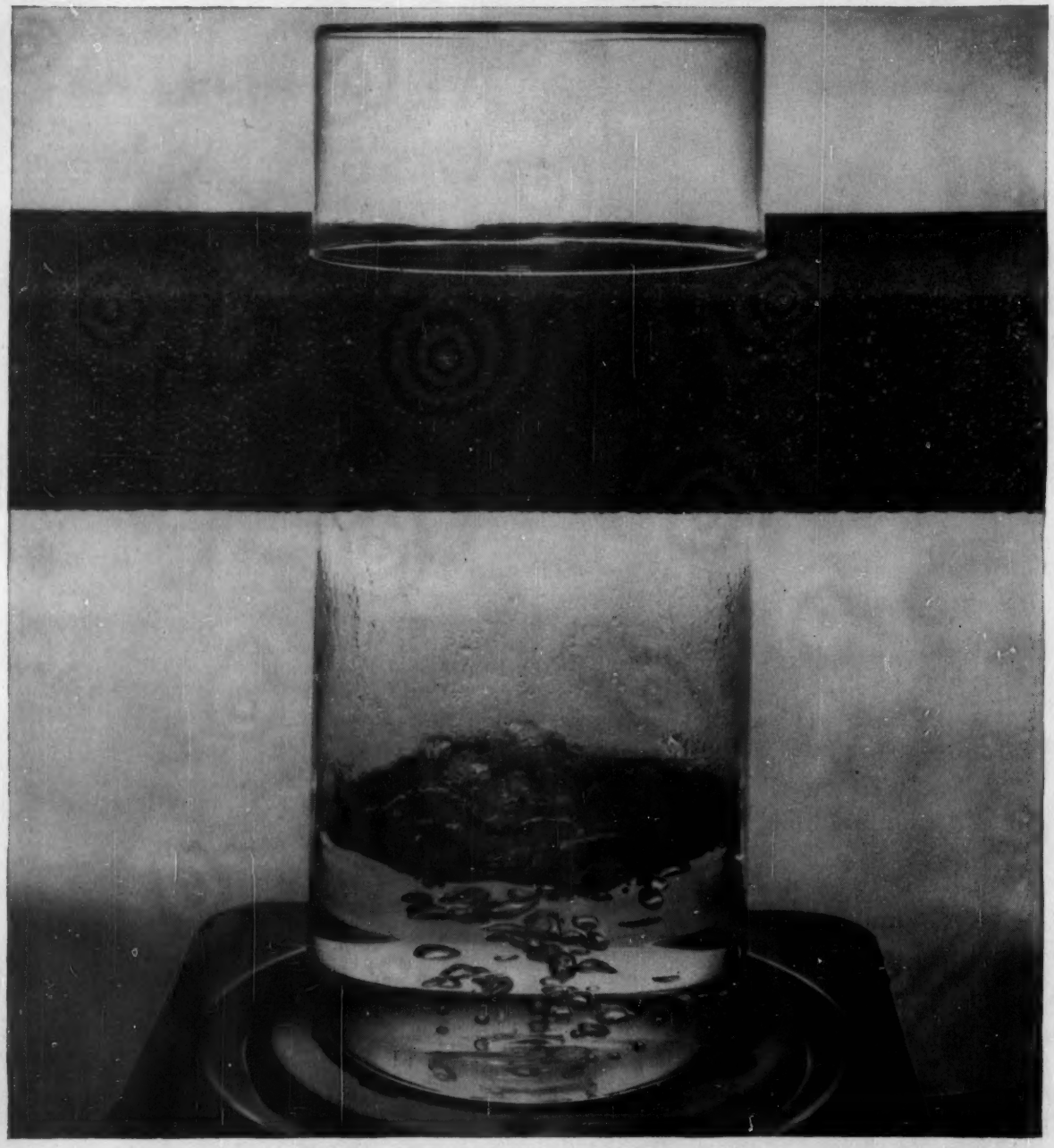
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Water vapor is the biggest threat to any insulation's thermal performance. It is present in nearly every situation requiring thermal insulation. Most insulations absorb vapor. When they do, the vapor can condense within the material . . . and turn the insulation into a conductor of heat. Eliminate this threat. Use Pittsburgh Corning FOAMGLAS. Its sealed glass cells can never absorb or transmit vapor (see above) . . . thus guaranteeing long lasting insulating value that never fades from its original high level. There's still more to this insulation investment story. FOAMGLAS is dimensionally stable . . . can't burn . . . unusually strong . . . acid-proof . . . vermin-proof . . . easy, economical to handle and install. Write for our latest literature. PC Glass Blocks are another outstanding building product of Pittsburgh Corning Corporation.

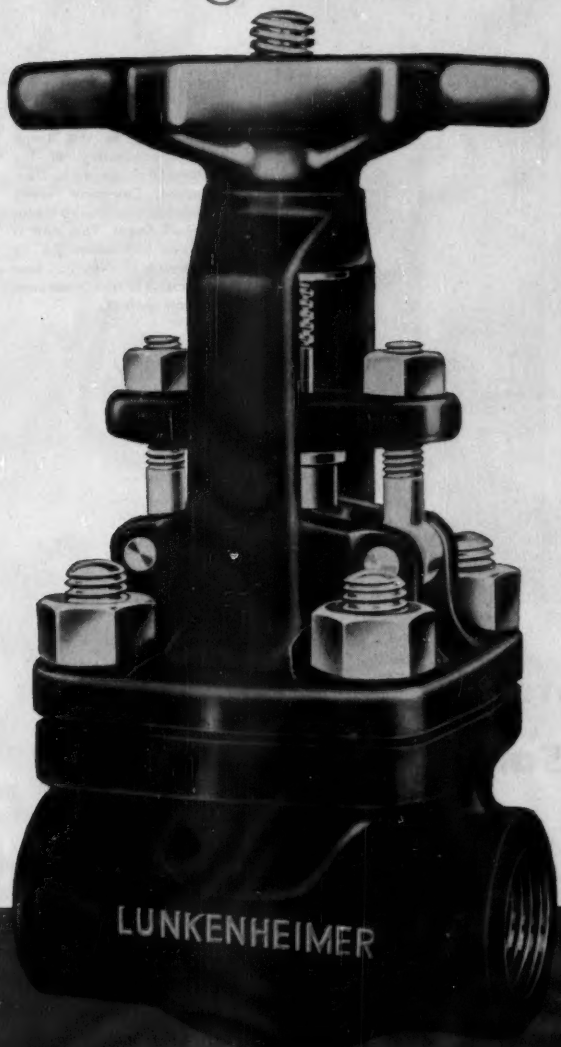
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NOW! AN ALL-NEW

Forged Steel Gate Valve

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Another addition to the world famous line. In design, materials, and workmanship, this new Forged Steel Valve offers traditional Lunkenheimer performance to cut your maintenance costs to rock bottom. It's compact to fit cramped installation areas, without excess weight—yet safely handles high pressures and temperatures. Discs are 500 Brinell 13 Chrome Stainless Steel. Precision machined guides keep the disc from dragging across seat rings. Hardened 13 Chrome Stainless seat rings are rolled-in—never loosen in service. A two-piece gland of ball-and-socket design prevents binding in stuffing box.

See your Lunkenheimer Distributor, or write The Lunkenheimer Company, Cincinnati 14, Ohio, for literature.

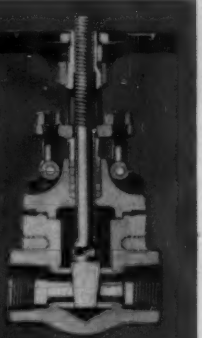
LUNKENHEIMER
QUALITY

Fig. 8001
OUTSIDE SCREW AND YOKE—BOLTED BONNET
800 lbs. 850 F—2000 lbs. 100 F
Fig. 8001—Screw Ends, Sizes ½"—2"
Fig. 8002—Socket Welding, Sizes ½"—2".



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A strong torque transmitting connection to yoke bushing is provided by a handwheel key. All parts easily dismantled and reassembled. Handwheel nut securely locked in place.

UNIFORM SEAT-DISC HARDNESS
Discs are 500 Brinell—not just on wearing surfaces but all the way through. Uniform hardness eliminates danger of chipping or cracking in service. Seat Rings are also hardened.



E 487 14

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THE ONE *Great* NAME IN VALVES



An operator in the Saran Process Laboratory of the Midland Division of The Dow Chemical Company loads material into a Stokes Vacuum Shelf Dryer. This unit is equipped wth nine, 24" x 36" drying shelves . . . and provides 3" free clearance between shelves.

Dow chooses Stokes Vacuum Shelf Dryer for Saran Laboratory

The new Saran Process Laboratory of the Midland Division, The Dow Chemical Company (Midland, Michigan), has installed a Stokes Model 238-F Vacuum Shelf Dryer. This equipment is being used for drying a variety of resinous products on a laboratory and developmental scale. This particular model was furnished as a complete package, including a Stokes 9KW electrically heated hot water system with temperature range of 80 to 210° F.

Stokes Vacuum Shelf Dryers enable the safe drying of heat or air-sensitive materials which must remain dormant during processing. Units are available for heating by hot water, steam or heat transfer liquids.

Fabrication is from ASME Code-inspected materials — by ASME Code-certificated welders — with final inspection according to ASME Code. All manifold connections are made outside the chamber, eliminating any risk of product contamination by internal leakage. Major components for a variety of shelf drying systems are stocked — for fast delivery, while meeting individual customer requirements.

Stokes produces rotary vacuum dryers, rotating vacuum dryers, vacuum shelf dryers, drum dryers and flakers, tabletting equipment . . . maintains a complete laboratory to provide expert application assistance. Write Stokes, or contact your nearest Stokes office for complete information.

Vacuum Equipment Division
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

STOKES

These Blaw-Knox steamchests show how (right) Trentweld tubes are inserted, (center) gas fusion welded to the tube sheet, and (left) welded and polished to well-rounded joints which leave no corners or crevices for bacteria or corrosion build-up.



high strength of TRENTWELD TUBING

reduces a steamchest's weight, increases its service life

Here's a case where the high strength of Trentweld® tubing reduced a steamchest's over-all weight while (1) increasing its service life, (2) improving heat transfer, (3) eliminating possible sanitation problems, and (4) reducing clean-up work.

These steamchests, made by Blaw-Knox Company for heating milk, frequently contain 3,000 feet of stainless steel tubing. Previously, Blaw-Knox expanded heavy-wall tubes into the tube sheet. Now, using welding techniques developed by Trent's Technical Service Group and Blaw-Knox welding supervisors, workers easily weld lighter gauge Trentweld tubes to the sheet and polish the joints. This eliminates any chance of bacteria growth during processing and of crevice corrosion during clean-up.

Trent's Technical Service Group can help you improve your product with Trentweld tubing, too. That's because Trent's exclusive welding process virtually eliminates any beads or undercuts, and because Trent cold works and anneals its tubing to make the weld as strong and corrosion resistant as the parent metal. The result? *Tubing that's as strong and uniform as tubing made by any other method.*

Mail coupon for catalog . . .

CONTOUR TRENTWELD TUBING is available in sizes ranging from ⅛" to 40" O.D. and grades including Hastelloy,* Zirconium, Zircaloy, Titanium, 19-9-DL—for applications in every industry.

*Trademark of Haynes Stellite Co.

CONTOUR TRENTWELD

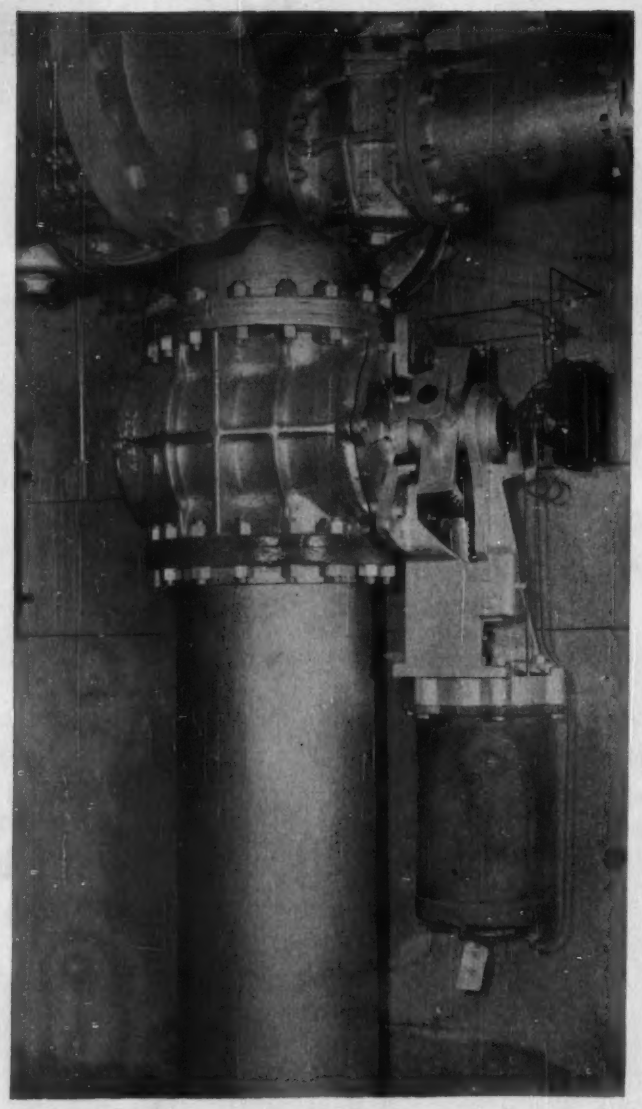
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***Or write: Trent Tube Company, Fullerton, Calif.**



What do you want in a control valve?

Precise Control?

DeZurik Control Valves have excellent throttling characteristics. They respond instantly, without cycling; they hold positively—without drifting!

Tight Shut-Off?

The rubber-faced plug of a DeZurik Control Valve shuts absolutely tight on any line—even with solids in the flow—without the danger of contaminating the flow with lubricants!

Compact Installation?

The cylinder operator on DeZurik Control Valves is mounted parallel to the pipe—it does not project at right angles to interfere with other installations.

Rugged Construction?

The cast bronze cylinder of DeZurik Control Valves, the stainless steel piston rod, the "O" ring seal on the piston . . . . all are designed to deliver longer life with minimum maintenance under any conditions.

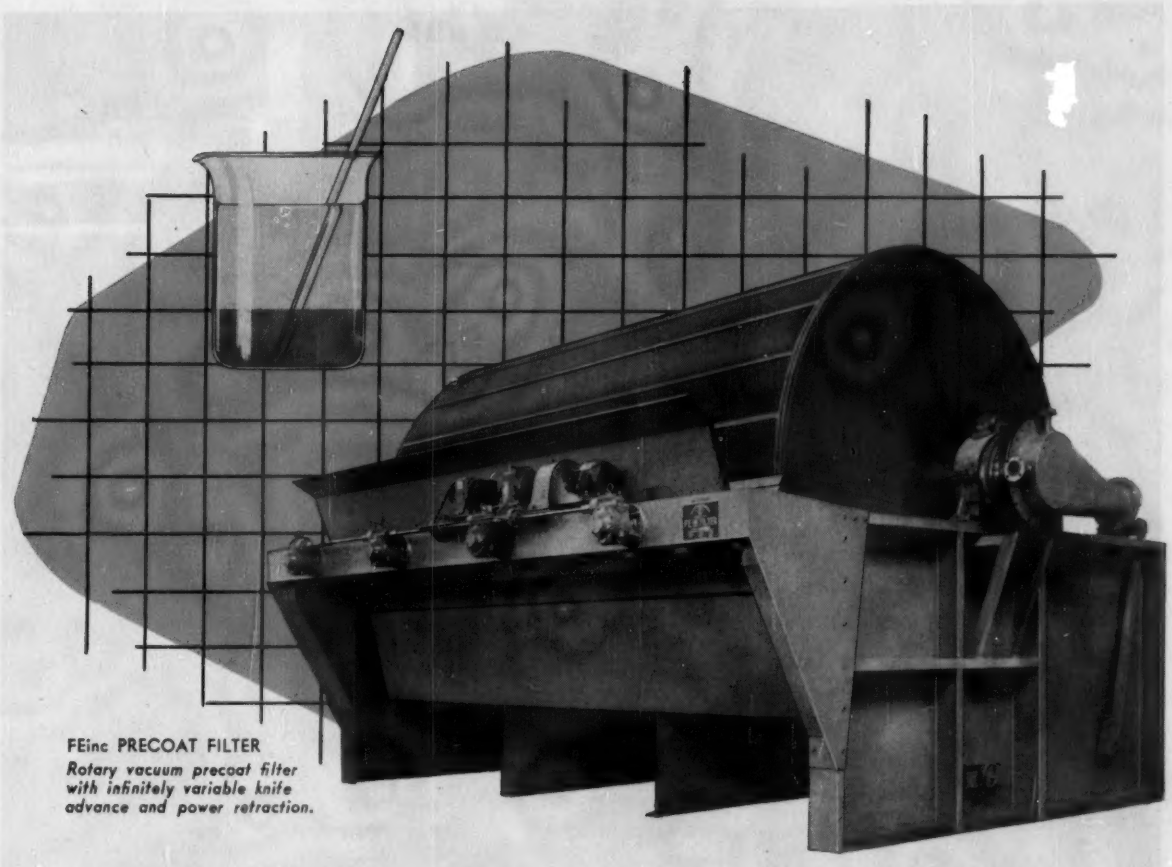
And there's more! DeZurik Control Valves with positioners permit cleaner, more simple control console installation; a ¼" copper air line in place of large hydraulic piping—a single control knob in place of a 4-way valve.



SMALLER DeZURIK CONTROL VALVES are equipped with totally enclosed operators. In large and small sizes, provision for manual operation is standard, and flow characteristics are changed easily, without changing the inner valve . . . . without dismantling the valve.

DeZurik Control Valves are available in sizes thru 20" and in a full range of materials. Ask the DeZurik representative in your area for more information, or write

DeZURIK CORPORATION
SARTELL, MINNESOTA



FEinc PRECOAT FILTER
Rotary vacuum precoat filter with infinitely variable knife advance and power retraction.

Custom Filter Design

BEGINS WITH YOUR FILTRATION PROBLEM

Your processing requirements are king at FEinc. They dictate the type of filter to be built, its size, the materials used, and the special refinements necessary to assure highest possible operating efficiency.

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If you require higher output in limited floor area and a long filtration cycle coupled with the above advantages, FEinc *custom design* can give it to you.

Send us your filtration problems. Specific recommendations provided without obligation.

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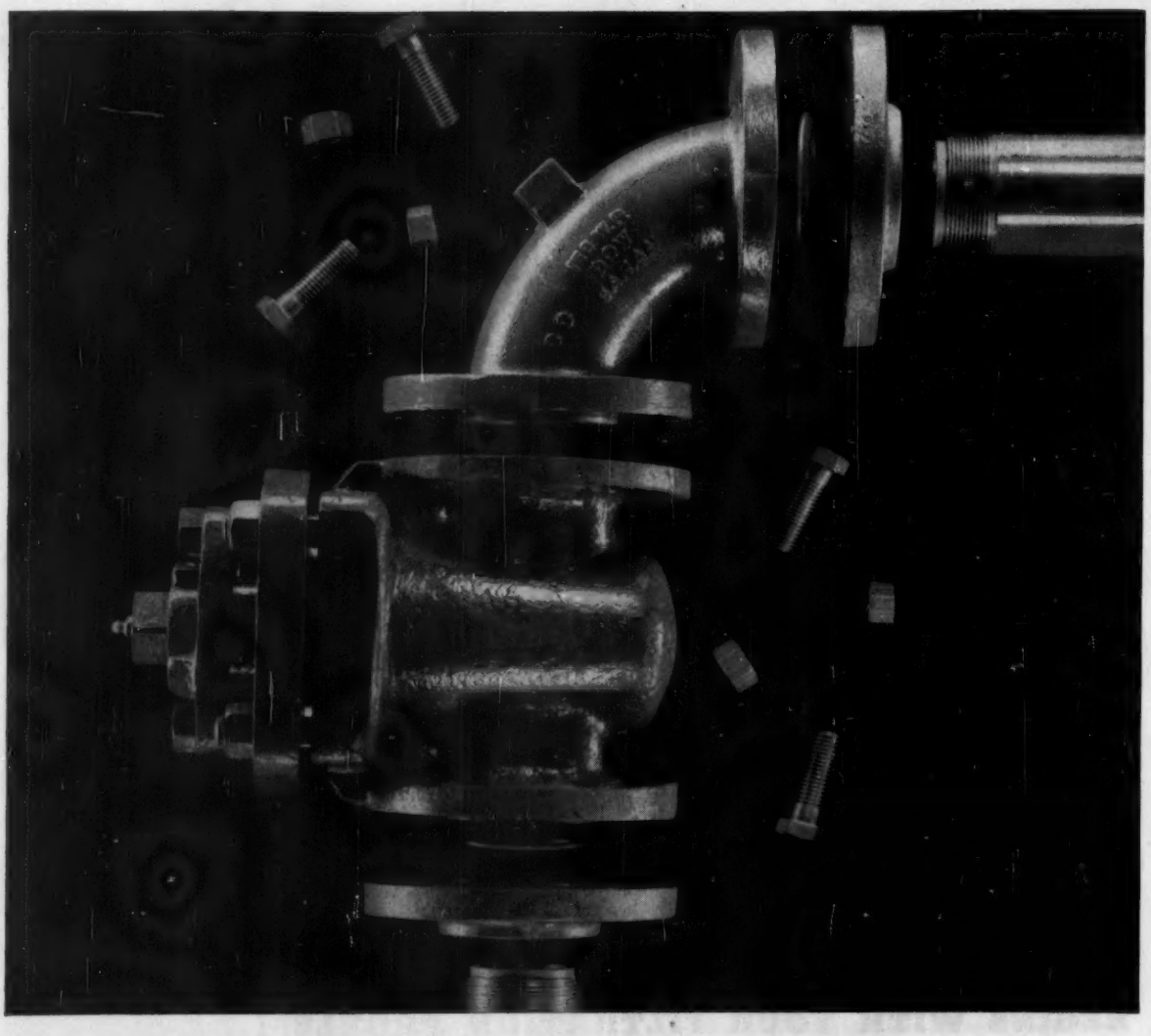
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You can see why Saran lined pipe cuts operating costs

. These corrosion-resistant pipes, fittings and valves are stock items, and they can be fabricated in the field

The long range economy of Saran lined pipe starts right here—with the immediate availability of pipe, fittings and valves . . . as stock items. There's no waiting . . . no price premium to pay.

And Saran lined pipe can be fabricated in the field. Only conventional hand tools or power equipment are needed to cut and thread it right on the job site.

Saran lined pipe pays off through the years with superior corrosion resistance and strength. When you specify the new gray Saran lined pipe, valves, pumps and fittings, you'll be able to pipe commonly used acids, alkalies and other corrosive liquids under a wider temperature range.

You can plan a *complete* corrosion-free pipe system with Saran lined pipe, valves, pumps and fittings. They're available for systems operating from full vacuum up to 300 psi and temperatures from −20° F to 200° F. Send the coupon today for further information. And be sure to ask about Saraloy® 898 tank lining, too. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY
DEPT. 2002A-1
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on: ☐ Saran lined pipe, fittings and valves ☐ Saran lined centrifugal pumps ☐ Saraloy 898 chemical resistant sheeting

Name_____ Title_____ Company_____

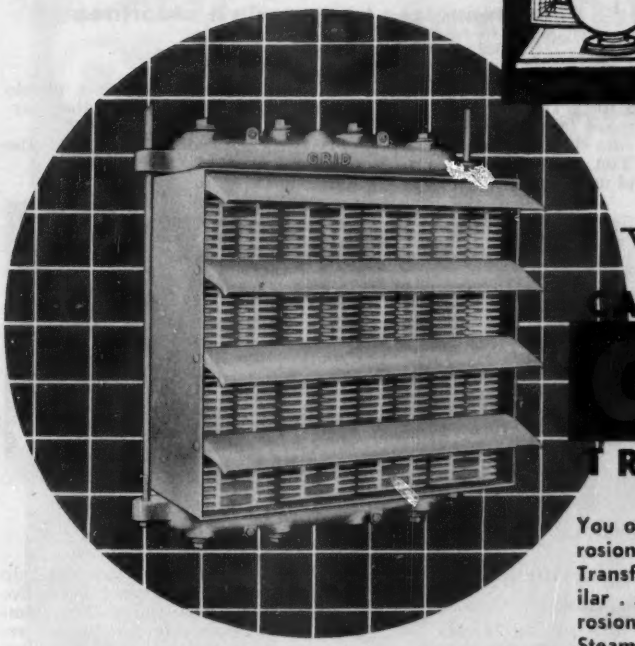
Address_____ City_____ State_____

YOU CAN DEPEND ON DOW



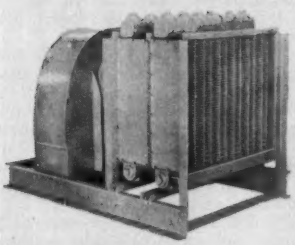
No Mystery-- No Magic-but Corrosion IN HEATING EQUIPMENT Ends When You Install

CAST IRON STEAM HEAT GRID TRANSFER SURFACE



You once and for all eliminate internal electrolytic corrosion because all metals in GRID Cast Iron Steam Heat Transfer Surface that are in contact with steam are similar . . . not 2 or 3 different metals that promote corrosion to cause leaks and breakdowns. GRID Cast Iron Steam Heat Transfer Surface also eliminates external corrosion because its cast iron construction resists acids or fumes in the air. When corrosion in heat transfer equipment ends, maintenance ends . . . it's as simple as that, no mystery, no magic, no "sales" talk. Your heating problems are no longer problems . . . you do away with high maintenance costs, repair work and the nuisance of leaky heating equipment.

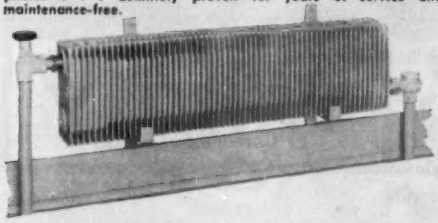
GRID Cast Iron construction eliminates the use of reducing valves where high steam pressures are used. It is designed to withstand steam pressures up to 250 P.S.I. . . . 450° temperature. GRID Cast Iron Steam Heat Transfer Surface does away with replacement costs because GRID is built to last for years . . . operating successfully without maintenance in many plants since 1929. Sounds worth looking into? Then get the complete story today . . . come the heating, you will be glad you did.



GRID BLAST HEATERS

Shown In Fan Assembly

A rugged, strong, and economical heat transfer surface, GRID Blast Heaters are designed for the tough job . . . for low and high steam pressures . . . require less labor for installation, less cubical space, and being designed and made the same as GRID Unit Heaters are resistant to corrosive atmospheres . . . definitely proven for years of service and maintenance-free.



GRID RADIATION

Designed for the tough applications in conjunction with high steam pressure systems, GRID Radiators eliminate the use of pressure reducing valves and because they are built with the same heating sections as GRID Unit Heaters, they will withstand steam pressures up to 250 P.S.I. . . . and wide fin spacing prevents collection of dust and dirt . . . particularly adaptable for factory, shop offices, store rooms, laboratories, etc. . . . any place where smaller heating capacities than required of a unit heater are needed.

29 YEARS MAINTENANCE-FREE SERVICE ON ALL TYPES OF GRID EQUIPMENT

Send for the complete story on GRID Unit Heaters, GRID Blast Heaters, and GRID Radiation for chemical plant use . . . it is contained in GRID Products Catalog No. 956. Write today for your copy.



D. J. MURRAY MANUFACTURING CO.

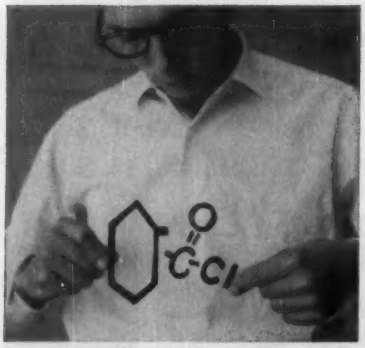
Manufacturers Since 1883

WAUSAU • WISCONSIN

OUR 75TH YEAR 1883 TO 1958

BRIEFS

on an easy way to get benzoyl groups ... a typical analysis of phosphorus oxychloride... "seeing" the purity of Nialk® carbonate of potash... a special plasticizer for polyvinyl chlorides



Easy way to get benzoyl groups

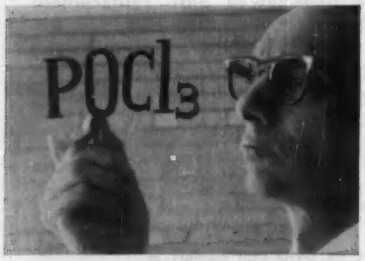
The fact that our benzoyl chloride is a minimum of 99% pure would have little to do with its sales were it not that this compound also offers an uncommonly ready source of the benzoyl group.

This clear, colorless liquid lends itself particularly well to Friedel-Crafts reactions, where it is used in making such compounds as benzoyl peroxide, benzophenone, and benzyl benzoate.

Its boiling point is 197.3° C. and it distills over a 3.5° C. range. Its freezing point, by the way, is not lower than a minus 0.9° C.

This is just one of four Hooker compounds with somewhat similar chemical properties. The others are benzyl chloride and the *para-* and *meta-* isomers of nitrobenzoyl chloride.

You can get complete technical data on any or all by sending the coupon.



Phosphorus oxychloride—just some facts

When we run a typical analysis of our phosphorus oxychloride we come up with such findings as these:

The chemical is typically 99.8% pure $POCl_3$. It contains only 0.01% PCl_3. It holds no free chlorine or phosphorus pentachloride. Iron shows up in such minute quantities that we label it less than 1 ppm.

The compound distills 98.5% between 106 and 107.2° C.

There are more facts like these in our technical data sheet on phosphorus oxychloride. You are welcome to a copy. Just send us the coupon.



Have you seen our K_2CO_3 on TV?

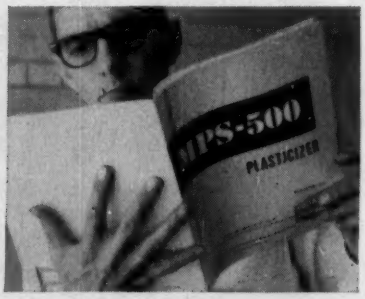
The glass used in making 21-inch TV tubes in this country contains approximately 5.5 pounds of Nialk carbonate of potash per tube, and there's a message of importance in this for you.

The simple fact is that glassmakers insist on a product pure enough to give them clear, transparent, and uniform tubes.

So it is that they turn to our *calcined* carbonate of potash which is 99% pure and then some. Of course, you may not need an anhydrous product, so we quickly mention our hydrated carbonate of potash which runs from 83.5 to 84% K_2CO_3. And, then there's our powder which runs 99% pure and another grade which runs from 91 to 94% pure. Not to mention the liquid which you can get in strengths from 47 to 52%.

All good reasons why more people use more Nialk than any other carbonate of potash.

To get more data, just send the coupon.



Formulators of vinyl chlorides take note...

We offer you a bulletin which can help you improve vinyl compositions in five different directions. Count them: Impart flame retardance. Get higher resistance to water, oil, and gasoline. Get high permanence on heating. Get high tensile strength and high flexibility. Lessen migration.

If you already use our MPS®-500 plasticizer, you've undoubtedly guessed that that is the subject of our bulletin.

In case you didn't already know, MPS-500 is a *stabilized* chlorinated ester of a fatty acid. It finds use, primarily with other plasticizers, in vinyl films, upholstery, drapery, electrical insulations, and shoe soles.

MPS-500 is completely compatible with the polyvinyl chloride polymers in ratios as high as 60 parts per 100.

But, if you are interested in facts, you'd do better to send the coupon for the bulletin. There's much too much to tell here.

For more information, check here and mail with your name, title, and company address.

- ☐ Benzoyl Chloride
- ☐ Benzyl Chloride
- ☐ *m*-Nitrobenzoyl Chloride
- ☐ *p*-Nitrobenzoyl Chloride
- ☐ Phosphorus Oxychloride
- ☐ Carbonate of Potash
- ☐ MPS-500 Bulletin

When requesting samples, please use business letterhead to speed delivery.

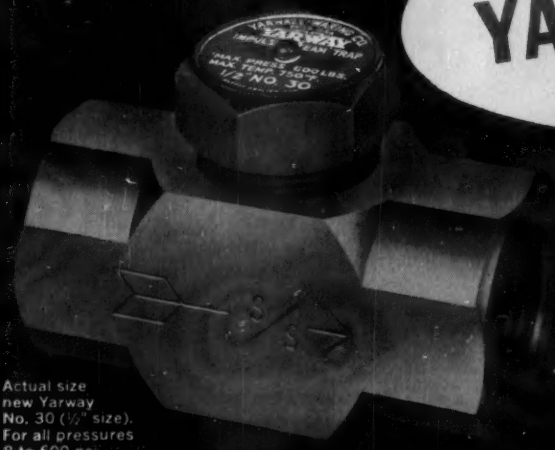
HOOKER CHEMICAL CORPORATION
408 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

Sales Offices: Chicago Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

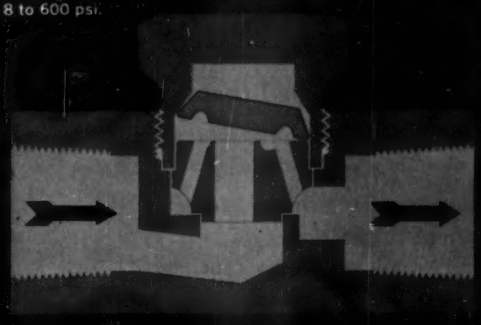
HOOKER CHEMICALS PLASTICS

NEW YARWAY IMPULSE* STEAM TRAP ENGINEERED FOR YOUR LIGHT LOAD REQUIREMENTS

YARWAY NO. 30



Actual size new Yarway No. 30 (½" size). For all pressures 8 to 600 psi.



Cross section Yarway No. 30 shows lever-valve in open position.

- **Economy of operation on light loads**
  - Closer shut-off
  - Quieter operation due to lever action
- **Economy of Maintenance**
  - Replaceable valve-seat assembly
  - One moving part
  - Stainless steel construction

Put this trap on tracer lines, steam line drips and other light load applications. Order from your local Yarway distributor.

For free bulletin, write Yarnall-Waring Company, 100 Mermaid Ave., Philadelphia 18, Pa.

*IMPULSE . . . A COMPLETE LINE OF STEAM TRAPS, OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE.

YARWAY impulse®

OVER 1,250,000 ALREADY SOLD

USE THESE YARWAY IMPULSE TRAPS FOR ALL OTHER STEAM TRAP NEEDS

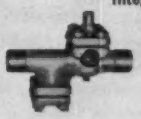
NORMAL NEEDS Famous Series 60 Impulse traps (pressures to 400 psi) and Series 120 (pressures to 600 psi) meet most normal needs

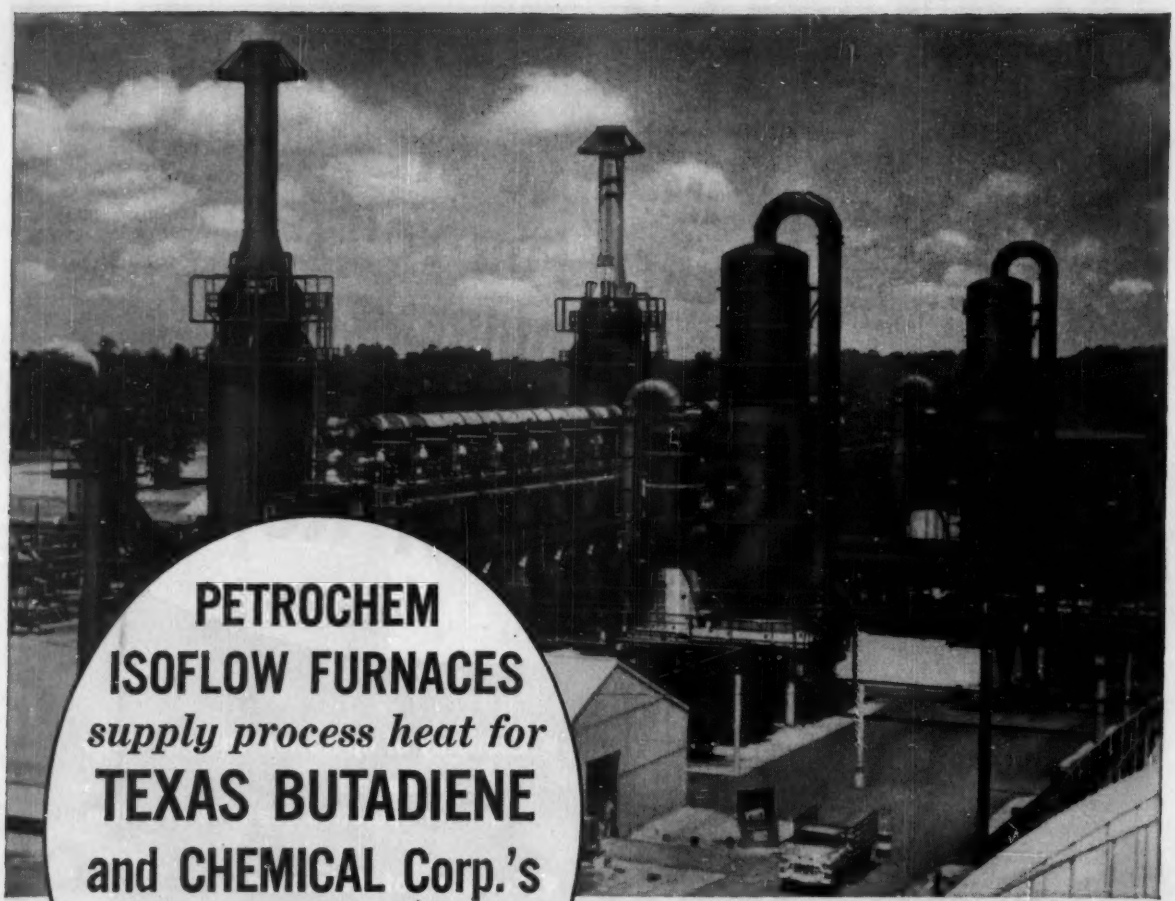


EXTRA HEAVY CONDENSATE LOADS Series 40 Impulse traps have extra large capacity to handle large volumes of condensate



POWER PLANT AND MARINE SERVICE Yarway Integral Strainer Traps fill the bill for marine and high pressure power plant jobs





PETROCHEM ISOFLOW FURNACES

supply process heat for

TEXAS BUTADIENE and CHEMICAL Corp.'s 86,000 TON BUTADIENE PLANT

. . . in fact, approximately 85% of all new butadiene capacity in the U.S. is processed through Petrochem "Isoflows."

The unique design and operating features which have led to the wide acceptance of Petrochem Isoflow Furnaces for butadiene production, catalytic reforming and other petroleum, petrochemical and chemical processes include:

• Uniform Heat Distribution • Maximum Fuel Efficiently • Low Pressure Drop • Low Maintenance • Zero Air Leakage • Minimum Ground Space • Simplicity of Design and Construction • Short Length of Liquid Travel • Series, Multipass, all parallel flow • Excess Draft for High Overload

There's a Petrochem Isoflow Furnace for any duty, temperature and efficiency.

Petrochem Isoflow copyrighted internationally

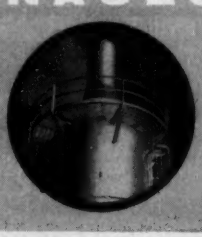
PETROCHEM-ISOFLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

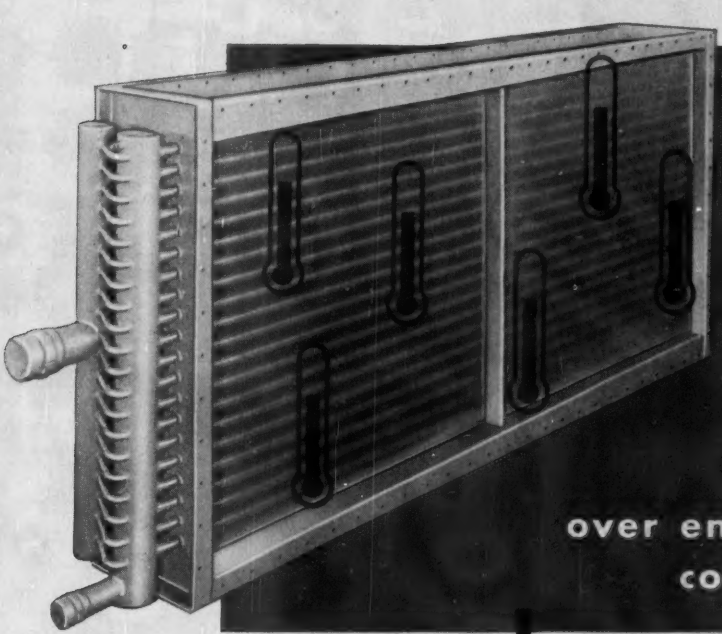
PETRO-CHEM DEVELOPMENT CO., INC. • 122 EAST 42nd St., New York 17, N. Y.

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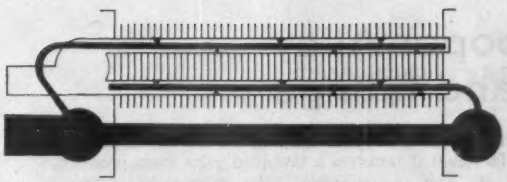
UNUSUAL NEW TYPE OF STEAM COIL DESIGNED TO PROVIDE



UNIFORM SURFACE TEMPERATURES

PRECISE TEMPERATURE CONTROL

over entire coil face area!



Marlo EVNTEMP

DISTRIBUTING STEAM COIL

Available in Corrosion Resistant STAINLESS STEEL

Here's a completely new approach to steam coil design and engineering—with no extra cost. The unique construction of the Evntemp provides uniform temperatures over the entire coil face area, throughout the whole operating range, even under extreme temperature modulation, and even in coils up to 10 feet long. Response to temperature control adjustment is almost instantaneous.

Steam supply and condensate connections are on same end; coils are pitched in casing for easy installation.

Evntemp coils can be designed for any temperature and pressure. A typical specification: tubes and headers of Type 304L seamless tubing, frames and fins of Type 304 stainless steel, all welding with special stainless steel alloys to prevent carbide precipitation.

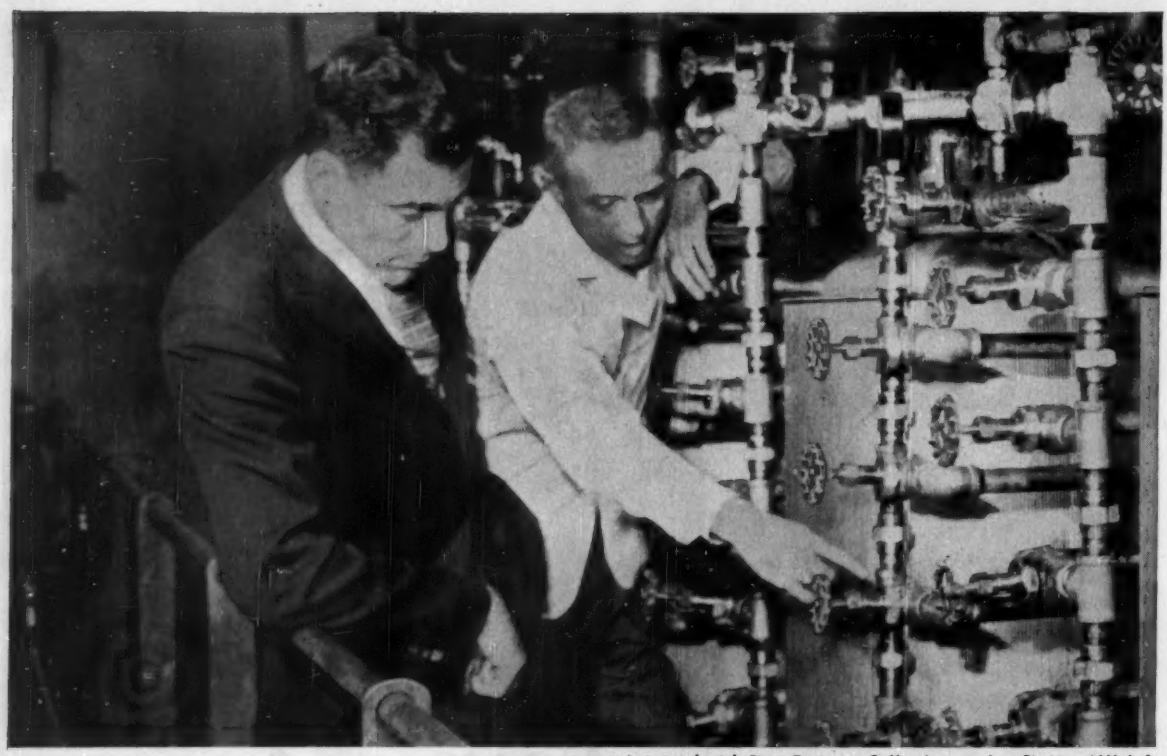
Send coupon for new Bulletin M-10 on this unusual new steam coil.

Marlo coil co.

SAINT LOUIS 11, MISSOURI

Quality Air Conditioning and Heat Transfer Equipment since 1925

MARLO COIL CO.
7118 S. Grand Ave., St. Louis 11, Mo.
Please send me a copy of your Bulletin M-10.
☐ I am also interested in stainless steel applications.
Name_____
Company_____
Address_____
City_____ Zone____ State_____



Joseph Smindak (right), Plant Engineer, Coffee Instants, Inc., Flushing, N.Y. Left, Michael De Piano, N.Y. representative, Cooper Alloy Corp. Foreground, Cooper Alloy 1" stainless Union Bonnet Globe Valves.

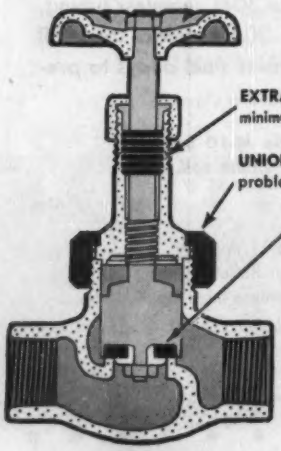
SMINDAK of COFFEE INSTANTS, INC.

Tells why he specifies Cooper Alloy for stainless steel valves and fittings

Q. Mr. Smindak, why does Coffee Instants, one of the nation's leading instant coffee processors, use stainless valves and fittings in processing their product?
A. To protect product purity, a must with us as with most other food processors. Contact with other metals can degrade flavor and aroma; stainless steel does not.

Q. Why Cooper Alloy?
A. Because of the special Cooper Alloy construction features I find combined in no other brand. On these Cooper Alloy union bonnet globe valves, for example, we like the ease of operation and the low maintenance; the fact that it removes a threaded joint from product contact; and in particular, the extra-deep square-compression stuffing box which reduces maintenance, gives a tighter seal at stem. Then too, the excellent service we get from Cooper Alloy sales people and distributors.

Q. You don't find these features in any competing valve?
A. Frankly, not one has them all. That's why, for our stainless valves *and fittings*, we insist on Cooper Alloy.



COOPER ALLOY Figure 15RD Globe Valve, inside screw rising stem, 200-lb. service, screwed ends, renewable retained disc of composition you specify.

YEARS AHEAD IN DESIGN SUPERIORITY! No matter what your valve type—globes, gates, angles, checks, or Y's—the Cooper Alloy model's outstanding design features will be important to you. Cooper Alloy, with 35 years of pioneering experience in stainless steel, does not merely adapt existing brass and iron valve patterns; it creates valves *designed to be cast in stainless!* **Check the special design features of valve shown at left.**

As the little CA man below is saying: *"You Can Tell A Cooper Alloy Valve As Far As You Can See It!"* Write today for *your* copy of our folder "Design Factors In Stainless Steel Valves." The Cooper Alloy distributor near you will be glad to show you the complete line of Cooper Alloy valves *and fittings*, and their advantages. He can serve you promptly from local stocks.

COOPER ALLOY
Corporation • Hillside, New Jersey
VALVE & FITTING DIVISION
THIRTY-FIVE YEARS OF STAINLESS STEEL PIONEERING

FOR FAST, SAFE BARGE LOADING

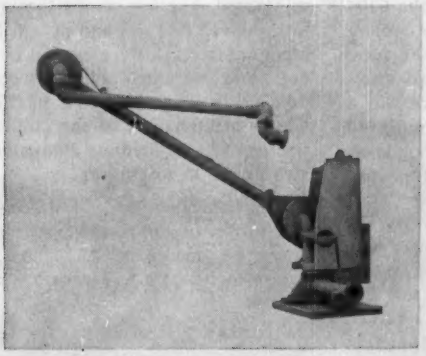
Clear the docks!



New CHIKSAN
BARGE LOADING ARM

SAVES ON

Line Handling Injuries
Dock Clutter
Lengthy Hookup Time
Hose Bursts
Replacement Costs



This newly developed barge loading arm ends hazardous manhandling of loading hoses, eliminates dangerous dock clutter. Mechanical operation makes hookup fast and simple... one man can handle the job in minutes with no physical strain.

Ball bearing swivel joints make it possible to rotate the arm to meet varying flange locations. After arm is flanged to barge riser, it can be left unattended. Arm will automatically conform to the various positions of the barge as loading or unloading is carried out. When not in use the operation arm can be raised up and out of dockside traffic.

Write For Illustrated Literature, Dept. 137

CHIKSAN

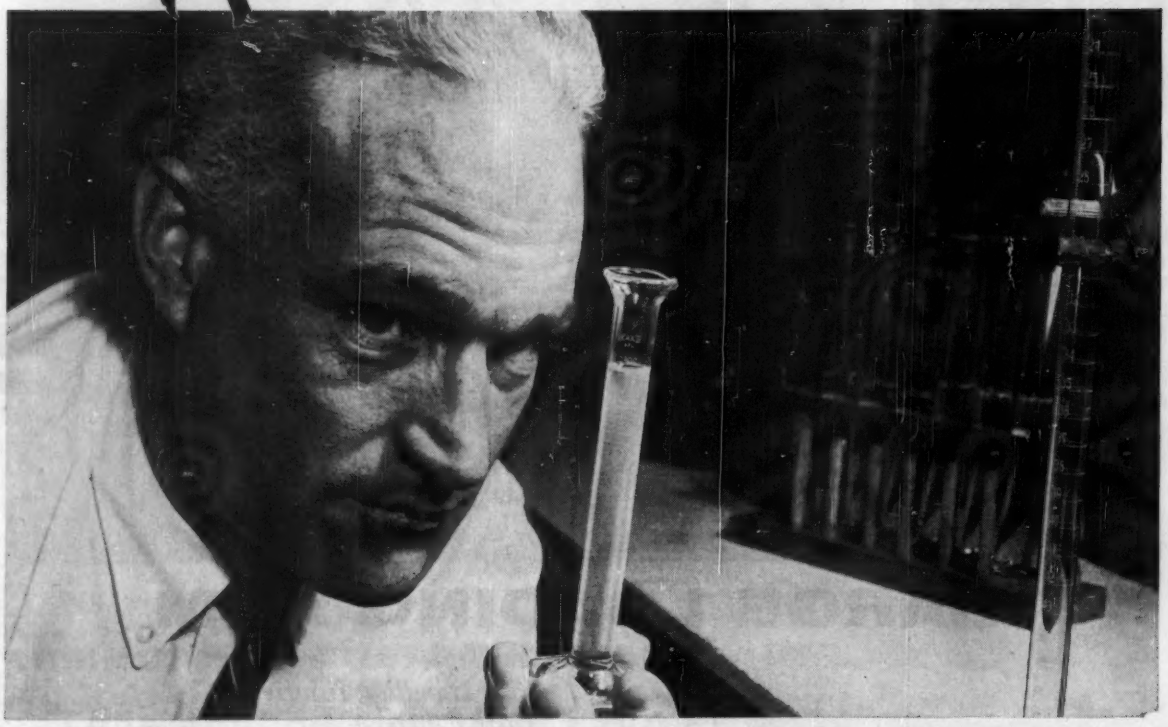
A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION fmc

CHIKSAN COMPANY— BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY
Well Equipment Mfg. Corp. (Division) Houston 1, Texas • Chiksan Export Company • Chiksan of Canada, Ltd., Edmonton, Alta.



BRIDGEPORT "T" MEN* IN ACTION

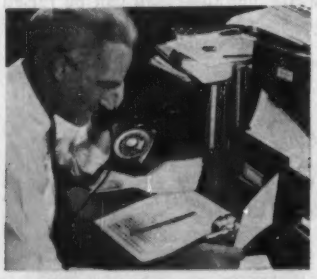
**Technical Service Men*



The Case of the Acid Assailant



Where's the Culprit? **Field spot tests of water samples give revealing clues as to cause of corrosion.**



Case Solved. **Initial recommendations go out to customers immediately and are followed by a detailed written report.**

It was an ordinary afternoon in the Corrosion Lab when a sample of raw cooling water and a corroded condenser tube arrived from a midwest chemical company. Accompanying the evidence was a letter of explanation and a completed Technical Service corrosion questionnaire. The customer wanted help. Bridgeport "T" men swung into action.

The water sample was analyzed. It checked out against the original sample taken when Bridgeport tubes were first installed. Still no conclusive evidence of corrosive media was found in the water. Yet, examination of the tubes revealed them to be corroded both by acid and an abrasive.

The Bridgeport "T" Man visited the plant site and retraced the case step by step.

The first break came when a spot check was made of water taken directly from the cooling tower. A significant acid content was noted. Further on-the-spot examination showed that gas and fly ash from the plant smokestack were carried by prevailing winds over the cooling tower and deposited in large amounts in the tower. Closer examination of the cooling tower uncovered acid-forming sludge and abrasive fly ash in suspension.

The Bridgeport "T" Man, in an extensive report of his findings, recommended corrective measures. Company adopted recommendations. Tubes saved. Case closed.

This is a typical case from the files of Bridgeport Technical Service, a group set up to help Bridgeport customers get maximum life and service from their power and process equipment.

For the best service and advice on condenser or heat exchanger tubes call your nearest Bridgeport Sales Office today.

BRIDGEPORT CONDENSER TUBES

Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

When piping changes direction, protect process equipment with

ZALLEA SELF EQUALIZING UNIVERSAL EXPANSION JOINTS

Zallea Self Equalizing Universal Expansion Joints absorb any movement in any direction . . . axially, laterally, angularly, or any combination of these . . . making them ideal for protecting process vessels and rotating equipment from thermal expansion of connected piping.

When there is a leg or 90° offset to a long run of pipe, one Zallea Universal Expansion Joint will frequently take care of the entire system.

Under conditions of low load requirement for anchors or equipment . . . or when compressive loading in pipe walls must be kept to a minimum . . . Zallea Universal Expansion Joints are the most economical answer to the problem. They absorb the internal pressure thrust. The piping system need only carry the relatively small deflection loads.

Many types of Zallea Tied Expansion Joints are designed especially to absorb lateral deflection or rotation when there is pressure in the line. Universal, Modified Universal, Hinged, Gimbal, Pressure Balanced and Universal Pressure Balanced Expansion Joints give you a choice of the type best suited to your particular application.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. Write, on your company letterhead, for your copy of Catalog 56. Zallea Brothers, 879 Locust Street, Wilmington 99, Delaware.

Zallea
expansion joints

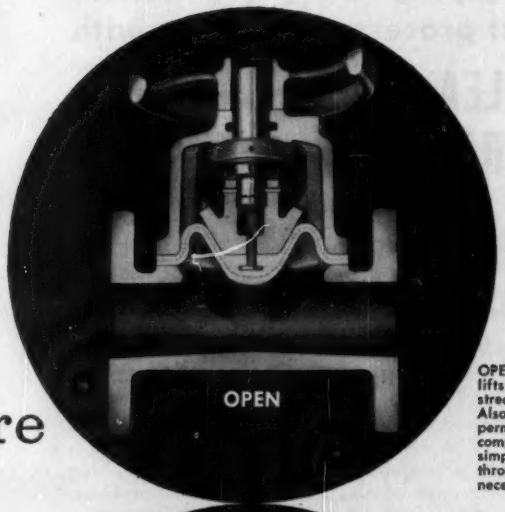
Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturer of expansion joints

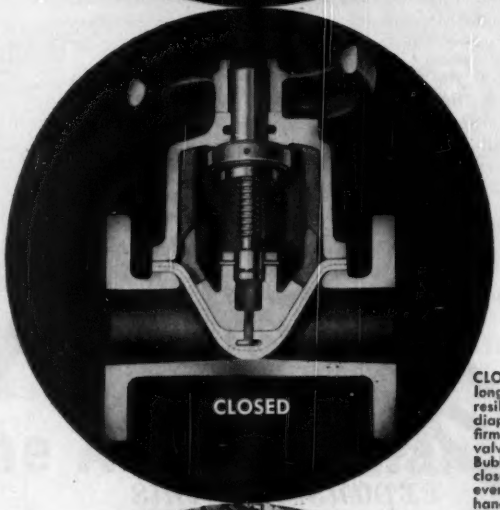


24" dia. Zallea Universal Self Equalizing Expansion Joints in service lines of the engine test facility of a West Coast aircraft manufacturer.

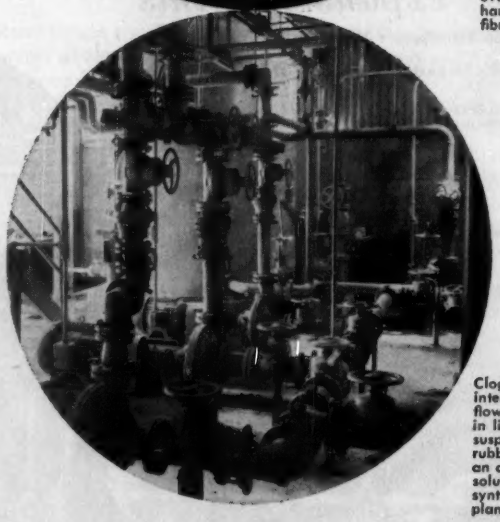
Maximum flow, minimum turbulence, negligible pressure drop!



OPEN Diaphragm lifts high for streamline flow. Also, valve design permits comparatively simple rodding through, when necessary.



CLOSED Despite long usage, resilient diaphragm seals firmly against valve body. Bubble-tight closure is assured, even when handling gritty or fibrous materials.



Clogging and interruption to flow is prevented in lines handling a suspension of rubber particles in an acid brine solution at this synthetic rubber plant.

GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVES* are unsurpassed for handling viscous materials — semifluid foods, latex, magmas; solids in suspension — slurries, pulp stock, sludges; fluid-borne abrasives; corrosive chemicals.

The straight-through design eliminates pockets, gate trenches and other obstructions which can trap solids. The result is maximum flow, minimum turbulence, and negligible pressure drop for a diaphragm valve.

The straight-through design also has the advantage of causing very little basic change in the direction of the fluid stream, thus reducing abrasive action from high velocity particles.

These advantages are in addition, of course, to benefits normally associated with the use of diaphragm valves . . . such as freedom from corrosion and clogging of working parts, since these are completely sealed off by the diaphragm; prevention of product contamination; elimination of stem leakage and routine maintenance, because there are no packing glands. Also, when properly pitched, lines are self-draining.

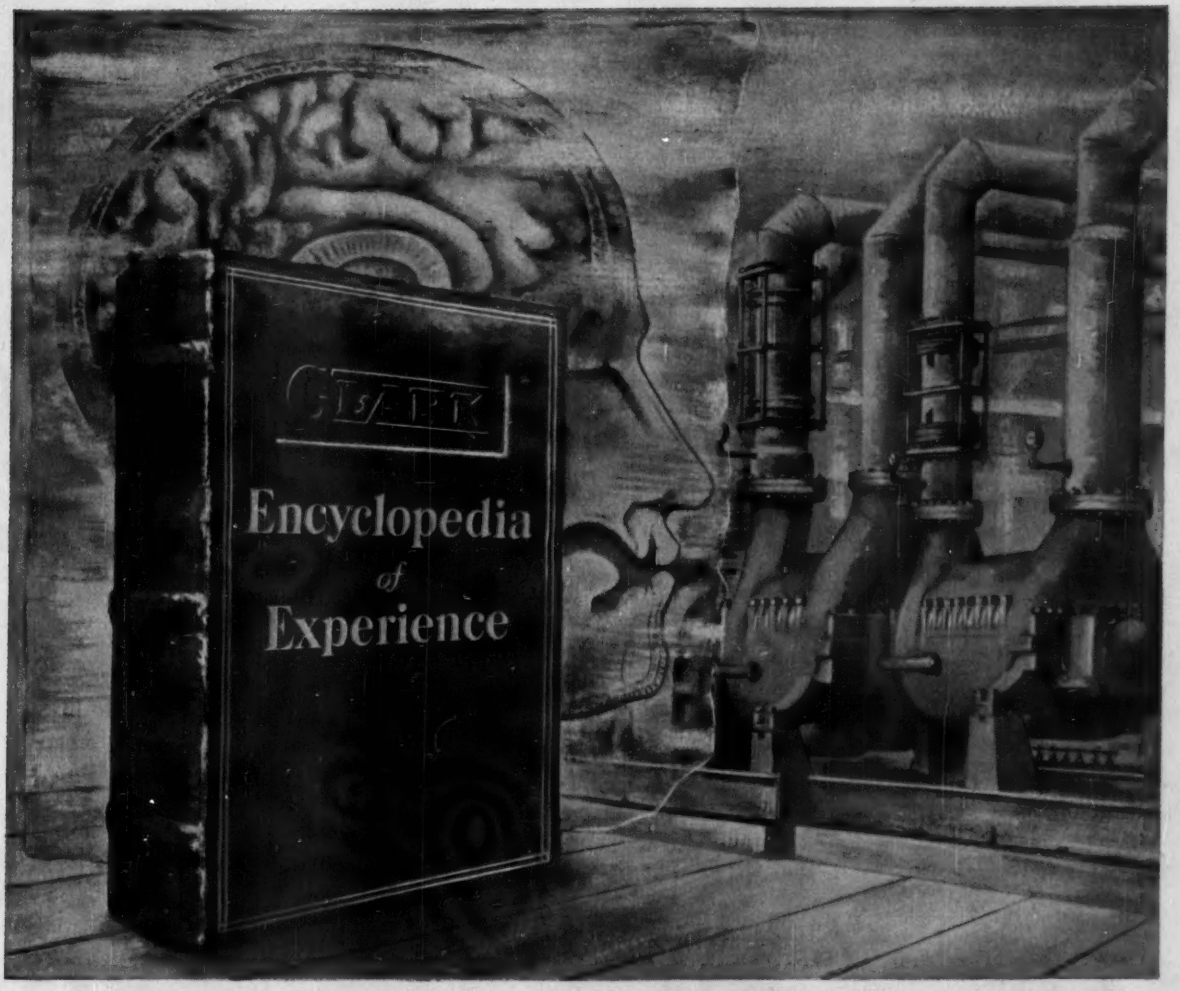
Grinnell-Saunders Straightway Diaphragm Valves are available in a choice of body sizes and materials, linings and diaphragms. Handwheel or power operated. For complete information, write Grinnell Company, Inc., 277 West Exchange St., Prov. 1, R. I.

*Patented

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



Behind every Clark Compressor and Gas Turbine is an **ENCYCLOPEDIA OF EXPERIENCE**

The performance of a manufacturer's products over the years reflects the knowledge and skills of their builder. This compendium of engineering wisdom at Clark Bros. Co. can best be described as the Clark *encyclopedia of experience.*

The field performance of Clark's heavy duty compressors, and the engines and gas turbines which drive them, has earned for Clark the reputation of building "precision by the ton". Clark engineering, supported by the Clark *encyclopedia of experience,* is responsible for this performance and precision.

From Clark's vast experience, the needs of industry for ever better machines have been met. From it have come the many Clark contributions to the petroleum, chemical, and process industries.

It was the Clark *encyclopedia of experience* which was responsible for: the balanced/opposed principle for compressors... the world's first 2-cycle turbo-supercharged gas-engine-driven compressors and the oil seal that made centrifugal compressors practical.

These are but a few of the "firsts" and of the developments, plus the precision and performance, with which Clark engineering is credited. All stem from the Clark *encyclopedia of experience.*

If you use air or gas, you can get full information about Clark products to serve your industry by calling your nearby Clark engineer. Or write Clark Bros. Co., 1801 Lincoln Avenue, Olean, New York.

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modern PLATECOIL® cuts heating and cooling costs



low installation and maintenance costs
greater heat transfer efficiency
lower space requirements



Write for free Bulletin P-61 "HOW TO CUT HEAT TRANSFER COSTS WITH PLATECOIL" for complete information.

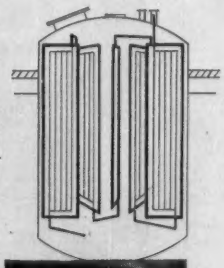
SHELL CHEMICAL uses PLATECOIL® in synthetic rubber reactors

Stainless steel PLATECOIL units remove heat liberated in synthetic rubber polymerization reaction at the Torrance, California plant of Shell Chemical Corporation.

High efficiency, low cost per unit surface, ease of cleaning and improved agitation are cited as benefits obtained through use of PLATECOIL in this application.

The PLATECOIL units were fabricated into vertical banks which appear in the photo taken looking down into the reactor. The other photo shows the top of the reactor with PLATECOIL units in the foreground before installation.

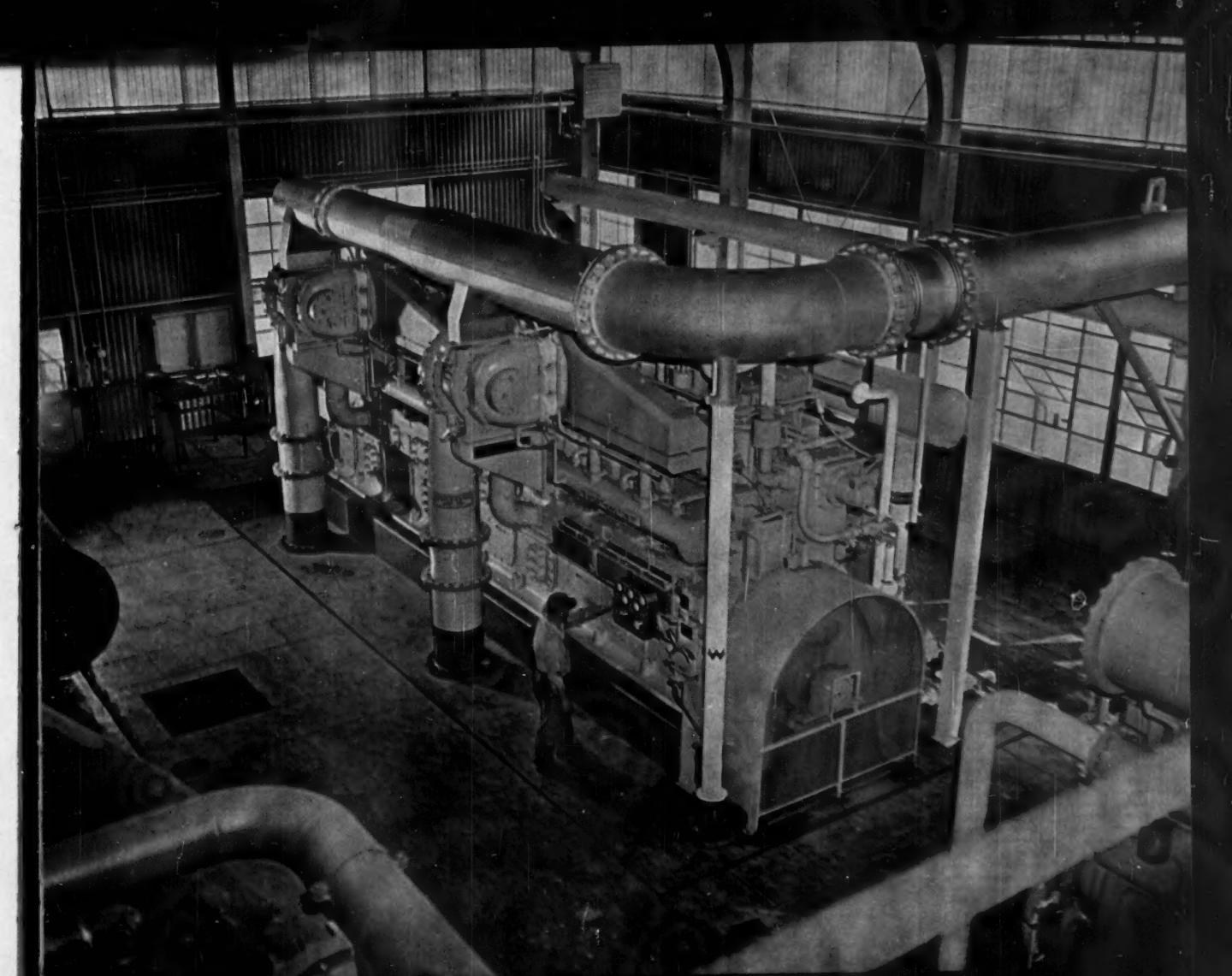
Tranter PLATECOIL units are available in a variety of metals and finishes, in factory fabricated banks and in styles rolled to specified diameters to conform with the curvature of tanks or vats.





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PLATECOIL® DIVISION

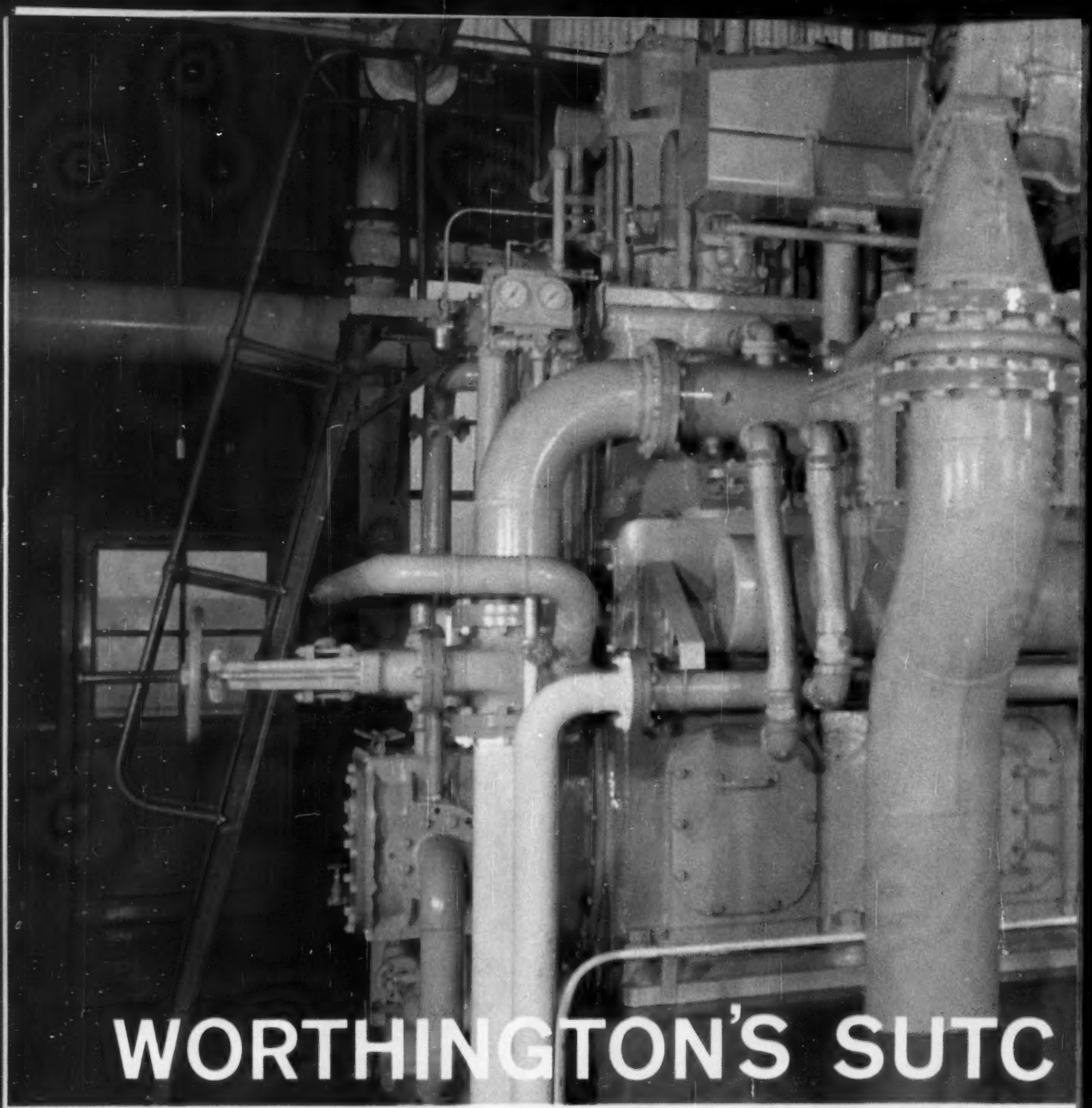


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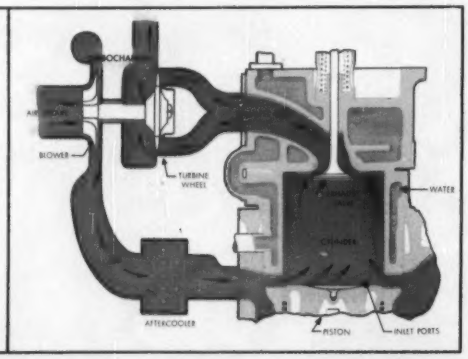


WORTHINGTON'S SUTC

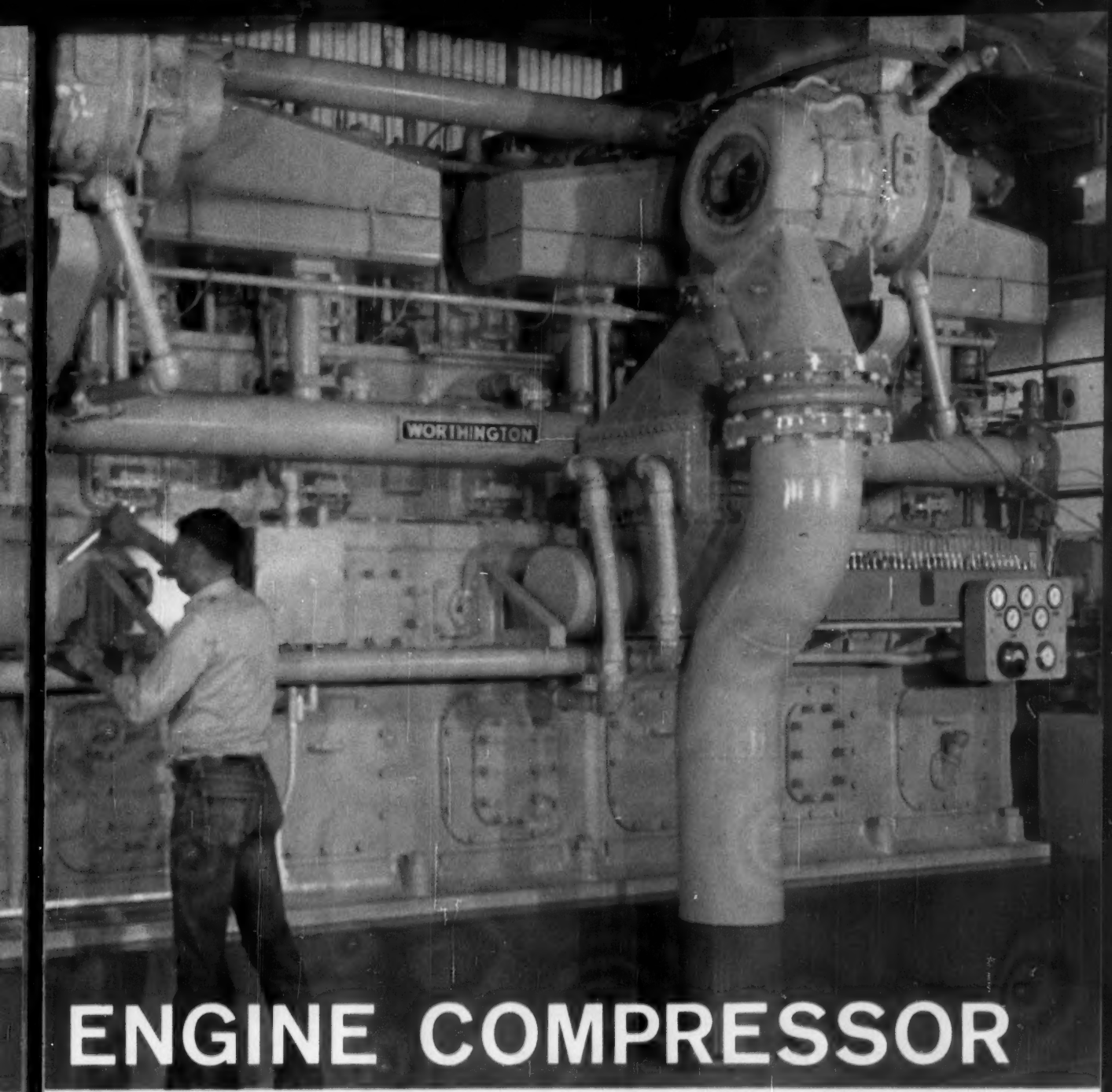
Easier starting, quicker loading,

TURBO-UNIFLO OPERATION

Straight through flow of air in the cylinder, the large inlet port areas (full 360 degrees), and the timed exhaust valves give maximum scavenging effectiveness with optimum back pressure.



Compact, reliable, efficient—the unique SUTC gas engine compressor with independent turbocharging has quickly become the outstanding engine compressor on the market. (Today, SUTC engines are in operation in chemical, petro-chemical plants and in pipeline service throughout the world!) Thanks to the self-sustained turbocharging feature the SUTC develops almost double the hp in the same space required by a non-turbocharged engine. Further, the field-proved Worthington TURBO-



ENGINE COMPRESSOR

most flexible in operation

UNIFLO system provides the most complete scavenging, resulting in a complete absence of residual gases in the combustion chamber.

Power — The SUTC integrates exhaust-powered turbocharging with field-proved Uniflo scavenging design for unequalled stability of performance over the complete range of speed and load requirements. The SUTC range: 1250 to 2500 hp. Supplied in 5, 6, 7, 8 and 10 cylinder in-line units.

Economy—No engine compressor in this range is more economical. Low fuel consumption stems from the fact that sufficient exhaust gas energy is applied to give full turbocharged effect through *all* speeds and loads without added mechanical means for driving the supercharger.

Efficiency — Operating at relatively high compression ratio, the Turbo-Uniflo design affords much smoother combustion characteristics than other engines with lower compression ratios. This is due to the positively controlled timing arrangement, cylinder configuration and design of the exhaust manifolding.

For complete details on the SUTC turbocharged gas engine compressor, call your nearest Worthington District Office, or write: Worthington Corporation, Section 43-2, Harrison, New Jersey. In Canada: Worthington Canada Ltd., Brantford, Ont.

WORTHINGTON



compressor-user survey shows

FEATHER VALVE PREFERRED 2 TO 1!

FEATHER VALVE

VALVE A

VALVE B

A recent survey of compressor users put the amazing Feather* Valve first by far in all four operating categories —simplicity of construction, efficiency, low maintenance cost and quiet operation. In addition, the Feather Valve was picked as the preferred compressor valve 2 to 1 over the nearest competing type of valve!

The lightest, fastest-acting valve available, the amazing Feather Valve provides very sharp action with virtually no slip or back-flow. It works with no impact . . . has no buffer plates or cushioning devices. Practically indestructible it assures long life with negligible maintenance costs. When buying your next compressor, look into Worthington's complete line of Feather Valve units. Worthington Corporation, Harrison, N. J.

*REG. U. S. PAT. OFF.

WORTHINGTON

DEVELOPMENTS . . .

AUGUST 11, 1958

Chementator

C. H. CHILTON

Industrial Rayon and Spencer Chemical have formed Ohio River Chemical Co. to build and operate $10-million, 20-million-lb./yr. caprolactam plant near Ashland, Ky. Owners will use product to make nylon-6 fiber and plastic.

Solid sulfur in slurry form may move via 500-mi. cross-country pipeline from Alberta natural gas fields to Pacific Coast. Special studies are now under way at University of Alberta for Foothills Products Pipe Line Ltd.

Frontier Chemical is entering the perchloroethylene business this fall with a facility at Wichita, Kan., sporting a new, homegrown process.

Polybutadiene: Next synthetic rubber?

Rumblings of research and development activity on polybutadiene rubber erupted late last month with announcements of pilot-plant production by both Firestone and U. S. Rubber. And Phillips Petroleum tells *CE* that a pilot plant at Bartlesville, Okla., has been quietly perking along for over a year.

Among others known to be active in the field are Shell Development and Montecatini. Phillips, Firestone and Montecatini are already at the tire-testing stage. Goodyear won't define its current interest, states it's a safe bet that "practically everyone in the rubber industry interested in synthetics has been or is doing work on the polybutadienes."

Thus the long search for synthetic polymers with properties similar to natural rubber seems to be zeroing in on several materials produced via the techniques of directed catalysis pioneered by Ziegler and Natta. Polyisoprene hit the headlines first; now it's 1-4 cis polybutadiene; next might be ethylene-propylene copolymers.

Polybutadiene should be somewhat cheaper to make than isoprene rubber because of the comparatively low price of the butadiene monomer. The Russians already have substantial facilities for making polybutadiene rubber.

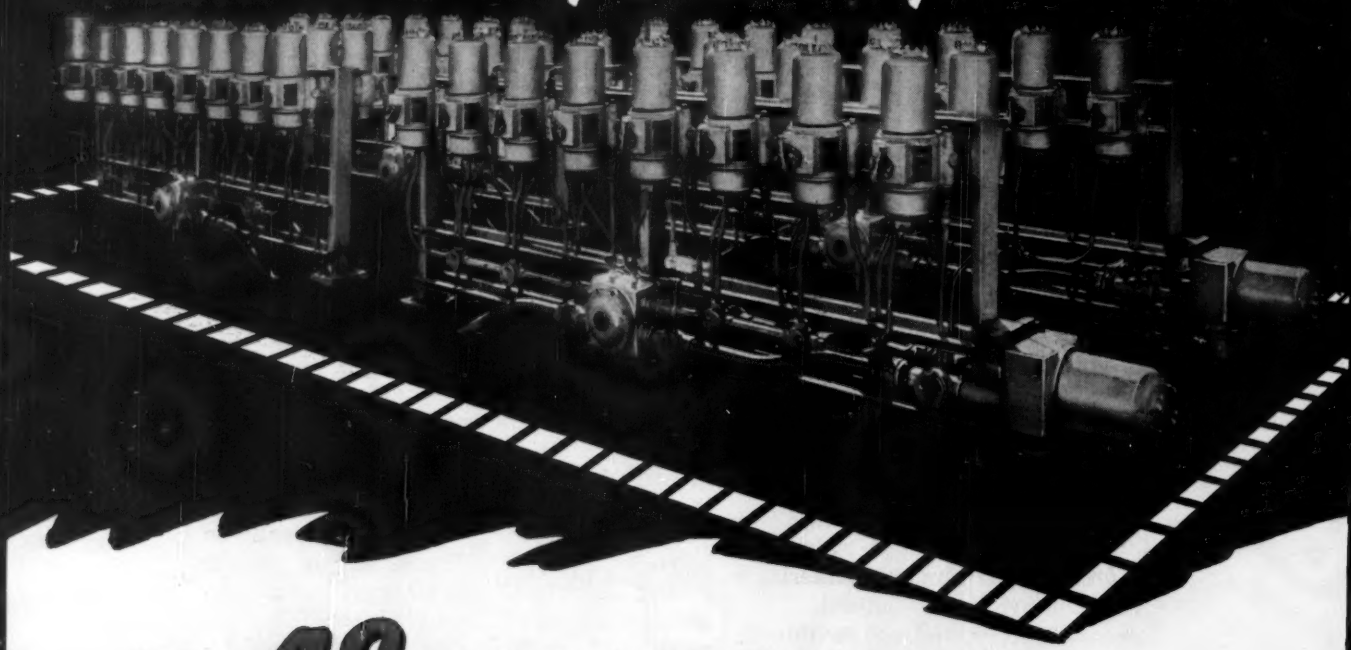
U. S. Rubber and Goodrich will be able to make all three of the new polymers in their pilot plants, including the C_2-C_3 copolymers. Montecatini's Natta nominates the latter as "more interesting" than polyisoprene or polybutadiene "because of their good elastic properties, coupled with tensile strength and resistance to aging."

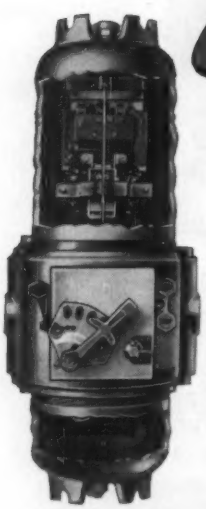
Pilot plant to win oil from tar sands

Union Oil Co., leader in oil shale development (*Chem. Eng.* Sept. 1957, pp. 146-8), is leaving no stone unturned in its search for

(Continued on page 73)

CROUSE-HINDS
Condulet* motor controls
Occupy Less Space!





48 Explosion-Proof Combination Motor Starters and Circuit Breakers . . . *in a 25 ft. x 6 ft. Area!*

Crouse-Hinds Condulet* Type EPC Motor Starters and Circuit Breakers are explosion-proof, dust-tight (dust-ignition-proof) and weather-resistant (raintight).

Lightweight cast aluminum construction for easy installation without use of lifting equipment.

Seven Conduit entrances simplify installation.

Built-in push button stations and selector switches are available.

Starter sizes 0 to 5. Circuit breakers 50 to 600-amp. frame sizes.

In the installation shown above, 48 Crouse-Hinds Condulet* Type EPC combination motor starters and circuit breakers are compactly arranged in four racks.

If necessary, the 25 ft. x 6 ft. area used could have been cut in half by installing the Condulet motor controls in two tiers. Or, *twice* as many Condulet controls could have been installed in the same area, if required.

The *vertical design* of Crouse-Hinds motor starters, circuit breakers and combinations allows them to be installed only ¼" apart. This compactness produces savings in the construction of steel mounting racks, and in the use of premium floor space.

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supplementary sources of crude oil. Now it's tar sands.

Company expects to put on stream this month a pilot plant for extracting low-gravity crude from tar sand deposits in Santa Barbara County, Calif. Capacity is 100 tons/day of tar sands; process details are unavailable.

Plans call for extract, plus a diluent, to be piped to Union's Santa Maria coking plant, 15 mi. westward. After coking, lighter fractions will be piped to the Oleum refinery.

Union estimates 50-million-bbl. reserve of usable crude in the area. The company also has tar sand holdings in the Athabaska region of Alberta.

How to lick corrosion in urea plant

New urea process developed by Dutch State Mines will make its Western Hemisphere debut next year in a new plant on the island of Trinidad.

The 70-ton/day urea unit is part of a $12-million project which will also produce ammonia, sulfuric acid and ammonium sulfate. Plant will be operated by Federation Chemicals Ltd., a new company in which W. R. Grace is financially involved. Engineering will be by C. F. Braun.

The DSM process has been operating for two years on a 150-ton/day scale in a Staatsmijnen plant in Holland. Two other plants are being built—a 140-ton unit for Societe Carbochemique in Belgium and a 300-ton unit for African Explosives & Chemical Industries in South Africa.

Outstanding engineering feature of the new process is the way in which it purports to handle the usually severe corrosion problems in the converter. A small amount of oxygen is purposely added to the reaction mixture; this makes it possible to get by with conventional stainless steels, says DSM. For example, the stainless steel expansion valves which let the reaction products down from converter pressure of 200 atm. have an estimated trouble-free life of four years.

Grace also operates a Pechiney process urea plant at Memphis (*Chem. Eng.* Apr. 1955, pp. 320-323). Does choice of the DSM process for Trinidad imply disenchantment with Pechiney?

Not at all, says Grace. The DSM process works fine for once-through operation, with recovery of unreacted ammonia as ammonium sulfate, a wanted product at Trinidad.

The Pechiney process, on the other hand, is eminently suited for complete recycle of unreacted ingredients as a slurry of ammonium carbamate in a neutral mineral oil, thereby avoiding the (U. S.) problem of what to do with byproduct ammonium sulfate. And demonstrating its confidence in the Pechiney process, Grace plans to boost urea output at Memphis to 120,000 tons/yr. from present level of 70,000 tons.

Crystallization: Some like it cold

Emphasis in this issue on that tricky unit operation, crystallization, brings to light some significant sidelights in the production of natural sodium sulfate.

Our Process Flowsheet (pp. 116-119) shows how West End Chemical Co. wins sodium sulfate from Searles Lake brine. Our Feature Report (pp. 125-140) comes from American Potash & Chemical Corp., West End's Searles Lake neighbor and prime competitor in the natural sodium sulfate business.

West End claims that its new cold (42 F.) crystallization process for isolating glauber salt is better than the evaporation process used by American Potash in its older plant. Did Report Author Garrett agree?

Yes. In fact, it turns out that AP&CC has also piloted a similar crystallization process and has it ready to go at such time as growing demand for glauber salt requires plant expansion.

Actually, AP&CC is already doing cold crystallization in a cheap, effective manner to boost its output. During the winter, when desert air temperatures often drop to 20-25 F., AP&CC sprays brine into the dry, open air. Glauber salt crystallizes out, piles up on the ground, is scraped up and trucked into plant. Company engineers developed suitable equipment and techniques (e.g., spray nozzles, materials-handling methods), gained a neat increase in capacity with a minimum investment in new facilities.

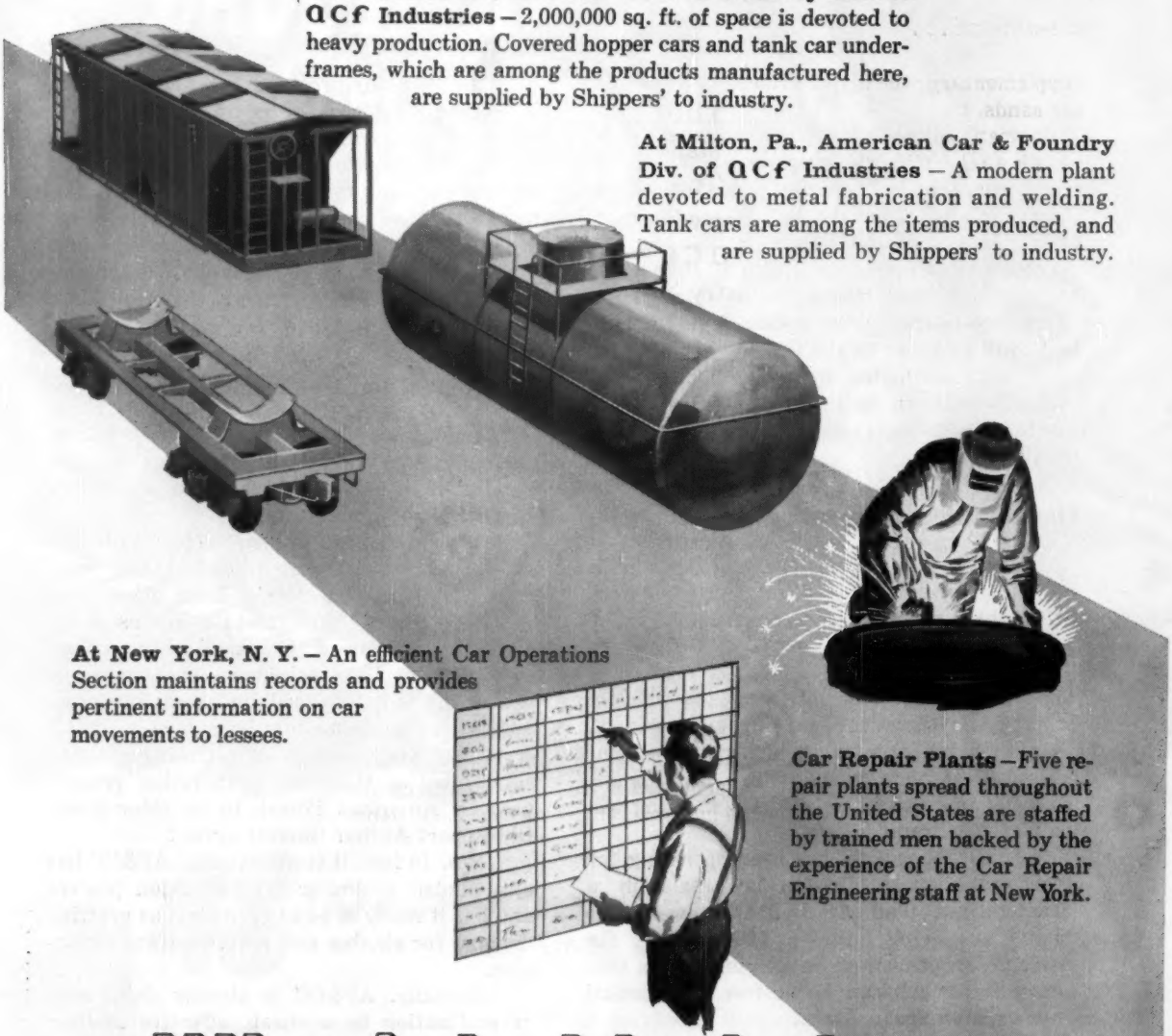
New tall oil process uses waste acid

Exporting tall oil technology to Sweden—ancestral home of this kraft mill byproduct—is like carrying coals to Newcastle. Yet De Laval Separator Co., Poughkeepsie, N. Y., is doing just that.

(Continued on page 76)

At Berwick, Pa., American Car & Foundry Div. of ACF Industries – 2,000,000 sq. ft. of space is devoted to heavy production. Covered hopper cars and tank car underframes, which are among the products manufactured here, are supplied by Shippers' to industry.

At Milton, Pa., American Car & Foundry Div. of ACF Industries – A modern plant devoted to metal fabrication and welding. Tank cars are among the items produced, and are supplied by Shippers' to industry.



At New York, N. Y. – An efficient Car Operations Section maintains records and provides pertinent information on car movements to lessees.

Car Repair Plants – Five repair plants spread throughout the United States are staffed by trained men backed by the experience of the Car Repair Engineering staff at New York.

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The full facilities of ACF Industries stand behind the man from Shippers'! The engineering and production "know how" which over the years has made ACF a standard for quality is available to industry in the tank cars and covered hoppers leased and sold by Shippers'.

Modern strategically located repair shops keep the leased equipment in excellent condition. Here as always, the ACF standard of quality and service is rigidly maintained. The prompt availability of car parts completes the picture of extras available to Shippers' customers.



ACF-DURADOME Tank Cars — modern way to safely ship all types of bulk liquids.



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Parts — A full complement of parts may be purchased through the Shippers' offices. This is facilitated by the newest parts catalog in the industry containing over 2,000 items.

Sales — Shippers' six Sales Offices are staffed by men eager to help and able to draw upon the total resources of ACF Industries in providing service.

De Laval's new process for continuous acid hydrolysis of tall oil soaps already has four U. S. installations to its credit. Next unit will be in a Swedish mill; five more domestic jobs are now in the talking stage.

Latest to come on stream is a 10,000-lb./hr. unit at Scott Paper's Mobile plant. Starting up early in June, it was turning out quality product within a week. June also saw issuance of basic process patent (U. S. 2,838,-481) to De Laval's Frank Sullivan.

Key steps in the process are continuous reaction of a proportioned amount of diluted sulfuric acid with kraft black-liquor skimmings (tall oil soaps), followed by separation of whole tall oil and waste with centrifuge.

Biggest development headache, says Sullivan, came in adapting the process to use waste sulfuric acid from chlorine dioxide pulp-bleaching plants. This required, among other things, redesign of centrifuge nozzles in synthetic sapphire (in place of tungsten carbide) and building the bowl out of Type 316L stainless. Two of the present processors are already enjoying the economic benefits.

Over in the refining end of the tall oil business, Monsanto and Emery Industries have just announced full production from their new joint distillation plant at Nitro, W. Va. Whole tall oil feed for the Nitro plant, incidentally, comes from a De Laval unit operated by St. Regis at Pensacola.

Inert lubes solve oxygen problems

Growing use of chemically inert, hazard-free synthetic lubricants for oxygen compressors is giving process industry users of tonnage oxygen an added degree of freedom.

With these lubricants—a series of liquid chlorotrifluoroethylene polymers made by Halocarbon Products Corp.—producers of low-pressure oxygen can use conventional internally lubricated, reciprocating or centrifugal compressors to boost gaseous product to process or pipeline pressure. Linde Co., now uses Halocarbon oils in its tonnage plants.

Despite their high price ($10-12/lb.), these materials permit simpler equipment and operation than such costly alternatives as:

- Water-lubricated reciprocating compressors, which usually require that the compressed oxygen be dried before use.
- Dry, carbon-ring reciprocating compressors, which are expensive to maintain.
- External-bearing centrifugal compressors, which cost more than those with internal bearings. (Wyandotte Chemical, for example, uses a Halocarbon-lubricated, 1,200-hp. centrifugal compressor to deliver oxygen to its new ethylene oxide process at Geismar, La.)
- Liquid oxygen pumps, which involve a more-costly separation plant and less-efficient recovery of refrigeration.

Halocarbon Products (Hackensack, N. J.) has produced these oils since its founding in 1950. The firm's founders helped develop inert fluorine-containing polymers on the Manhattan Project. Atomic energy is still the biggest market, but oxygen production and rocket propulsion are gaining rapidly.

Electrolytic alumina on the horizon

Interest in the Lobeth-Guareschi process for electrolytic production of alumina from clays and other low-grade raw materials has surged with the issuance in May of a basic patent (U. S. 2,833,707) to Pietro Guareschi of Italy. With patent protection in the bag, licensing agency Lobeth Corp., Chicago, expects a plant commitment by year's end.

Pilot-plant tests in Genoa on prospective raw materials from various parts of the U. S. are reported to have demonstrated effective, economical operation. Additional tests show promise for such disparate materials as Wyoming anorthosite and a South American clay containing 45% iron.

In the Lobeth-Guareschi process (*Chem. Eng.* Oct. 1954, pp. 130-6), pulverized silica-alumina ore (e.g., clay, kaolin, feldspar) is roasted, converting alumina complexes to alumina. Slurrying with sulfuric acid, thickening and subsequent steps to remove unwanted metals yield an aluminum sulfate solution. Electrolytic cells at 4-5 v. decompose the solution; aluminum hydroxide comes off at the cathode, sulfuric acid at the anode. The hydroxide is finally calcined to alumina.

The conventional Bayer process (which requires high-grade bauxite), as well as most other proposed routes based on low-grade ores, uses an alkaline reagent rather than sulfuric acid. Lobeth's acid approach is shared by Strategic-North American Coal (*Chementator*, May 5, p. 50). The SNAC process, however, purports to recover H_2SO_4 without resorting either to a sulfate electrolysis or a contact acid plant.

For more on DEVELOPMENTS.....78



Making Liquid Alum Water White . . .

with **DARCO®**

Activated Carbon

Making tons of a heavy chemical to tight color specifications sounds like quite a trick. That's the problem that was faced by producers of liquid alum for paper makers. When they put DARCO activated carbon to work, the outlook . . . and the alum . . . brightened considerably. In contrast to chemical bleaching methods, adsorption with DARCO physically removes impurities . . . gets rid of them permanently, leaving no chance for color reversion. Purification with DARCO is simple, safe. And it's amply economical to be practical for volume chemicals.

Many heavy chemicals with rigid specifications can be purified economically with DARCO . . . whether the problem is color, odor, floc-precursors, colloids or causes of haze or foam. There's a grade of DARCO that will give you the combination of adsorptive capacity, filterability and purity that's best for your job. Chances are we've run across an application similar to yours in the 40 years we've specialized in adsorption, and will be able to give you some tips that will help you save time and money. Call or write us today for DARCO data or a consultation.

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Brantford, Ontario, Canada

Organotins Gird for Growth Period

Bolstered by record 3-yr. growth, organotin maker quadruples capacity with first full-scale plant.

Eyeing a bright future for organometallics, Metal & Thermit Corp. now has taken the big step toward that future. Following more than a decade of semiworks operation at Rahway, N. J., M & T has shifted into 2.5-million-lb./yr. production of these exotic chemicals at its new $3.5-million, Carrollton, Ky., facility.

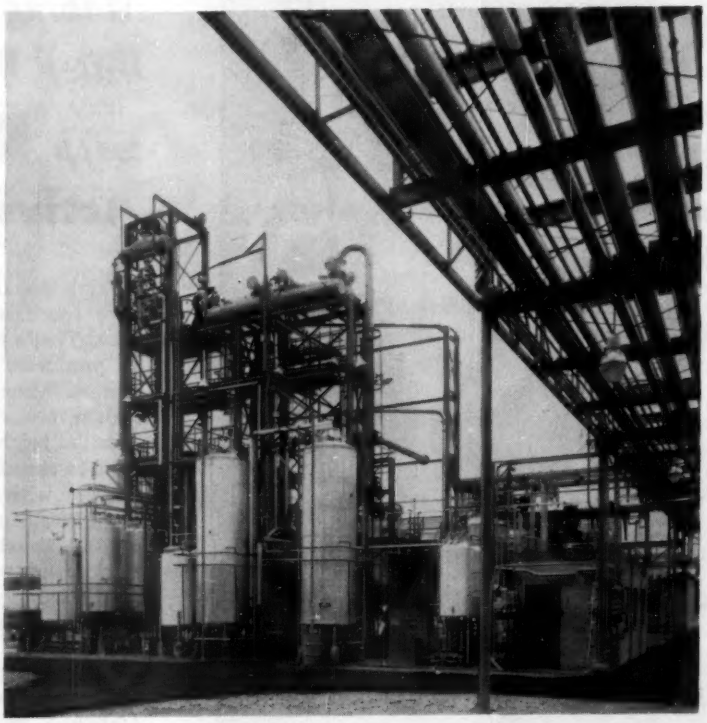
As commercial pioneer of organotins, M & T relied on its own engineers under Engineering Mgr. H. A. Rack to design and construct Carrollton, a 4-fold scaleup from the Rahway semiworks. M & T's choice of "do-it-yourself" produced a finished plant which started up in April, with remarkably few "bugs," under the direction of Plant Mgr. Arthur A. Mandell.

▶ **Growth Curve Steepens** — What's the spur behind M & T's decision to expand so vigorously at this time?

In the first place, well-established markets for organotin compounds have grown handsomely. During the past three years, domestic sales of these chemicals have climbed some 30%.

But M & T is looking beyond this record for something to accelerate this steady growth. The company's intensive research and development work in organometallic chemistry has turned up an impressive slate of highly promising new compounds.

Explains M & T's Production Mgr. Don Oakley, "You can draw a rough analogy between organometallic chemistry and silicone chemistry. As with silicones, you can synthesize virtually unlimited numbers of different organometallics. And each configuration possesses unique properties that open a vast variety of potential applications."



SYNTHESIS of dibutyltin dichloride is gateway to other organotins.

That's why the company feels that these new compounds will quicken growth of the market. Added to a noteworthy growth record, to date, it's reason enough to construct the Carrollton facility.

▶ **Products and Uses** — Right now, Carrollton turns out some 19 compounds, including dibutyltin diacetate, dilaurate, maleate, oxide, sulfide, dichloride and mercapto esters, as well as tetrabutyltin, tetraphenyltin, etc. Organometallics of antimony and phosphorus, now in pilot plant, also will be made at Carrollton.

Standout application for these compounds currently is in light and heat stabilization of vinyl resins. About 1-2% of dibutyltin dilaurate, or mercapto ester, added to PVC resin, arrests breakdown of halogen content, permits processing at high temperature without discoloration, makes finished plastic light-resistant.

Other organotin applications include use of tetraphenyltin and tetrabutyltin in polymerization catalysts, dibutyltin sulfide as a lubricity additive, tributyltin oxide in fungicides and bactericides, dibutyltin oxide as condensation catalyst, dibutyl-



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As a producer, Oronite does not compete with its customers by using its phenol production for end-products. As your demands for phenol based end-products constantly grows, Oronite will be able to supply your increasing needs.

And, because Oronite is the only U. S. phenol producer with complete control of raw materials and manufacturing, increased production capacity is no problem. Your growing phenol requirements can be met promptly. By doing business with Oronite there is less chance of any interruption in supplying your needs.

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It will pay you to get the full Oronite phenol story. Contact the Oronite office nearest you.

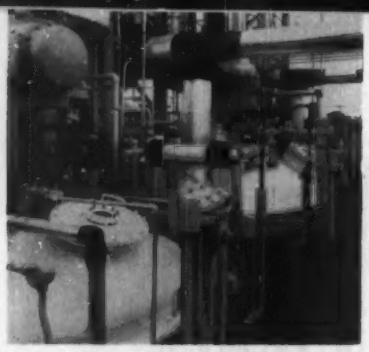
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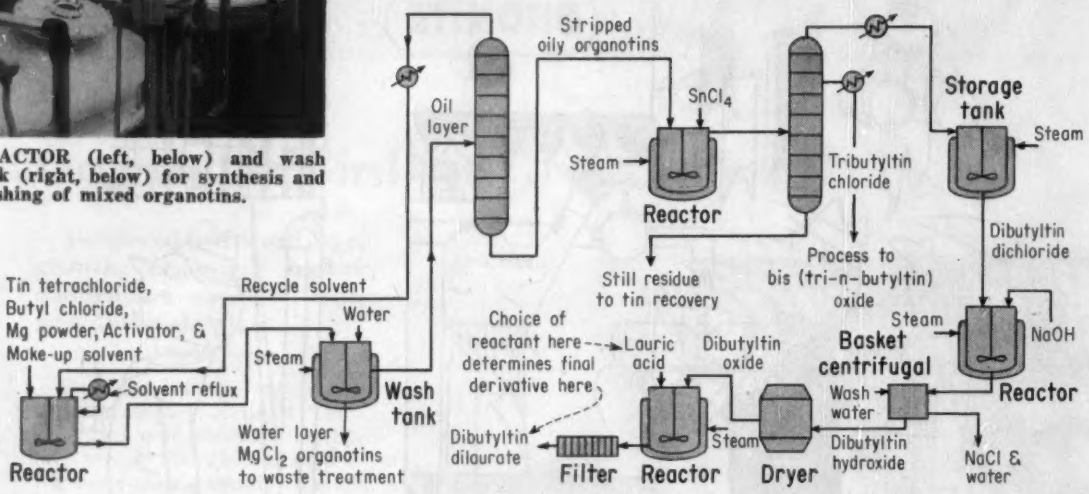
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REACTOR (left, below) and wash tank (right, below) for synthesis and washing of mixed organotins.

How M & T Builds Organotin Compounds



tin diacetate in curing catalyst for silicones, and various organotins for use in poultry medicines.

▶ **Organometal Basis** — Rigorously, only a molecule containing a carbon-to-tin bond qualifies as an organotin compound. At Carrollton, chief way to build configuration is via the Grignard reaction, though a direct and a Wurtz reaction also will produce organometallic compounds.

For example, tin tetrachloride and butyl chloride react with magnesium Grignard reagent in an inert solvent containing an activator. This produces a mixture of butyltins, namely tributyltin chloride, tetrabutyltin, dibutyltin dichloride, butyltin trichloride and, of course, magnesium chloride.

Primarily, M & T wants to recover dibutyltin dichloride. In Oakley's words, "It is the granddaddy of all organotins, being the primary intermediate for all organotins."

So mixed butyltins from the Grignard reaction are reacted with stoichiometric quantity of tin tetrachloride at about 480 F. Dibutyltin dichloride product is distilled from the reaction and reacted with caustic soda to produce dibutyltin oxide.

The oxide, in turn, reacts with sulfur compounds, acetic acid, maleic acid, various fatty acids to produce acetate, sulfide, laurate, maleate, etc., organotins. Too, some of the intermediates from these reactions, such as tetrabutyltin, and dibutyltin oxide, also are marketable.

▶ **Process Flow**—Tin tetrachloride, butyl chloride, solvent and activator, and powdered magnesium are fed to a 1,500-gal. carbon steel, agitated, batch reactor. Continuous refluxing of the solvent through an external water-cooled condenser holds temperature around 104-113 F. during the 6-7-hr. exothermic reaction.

Reactor discharges to a 2,000-gal. steam-jacketed, agitated water-wash tank which holds charge above 104 F. to prevent solidification of dibutyltin dichloride.

After agitation, charge is allowed to separate into water and oil layers. Water layer, containing $MgCl_2$ and slight traces of organotins, is decanted off. Oxidation and filtration remove toxic traces of organotins before disposal of water.

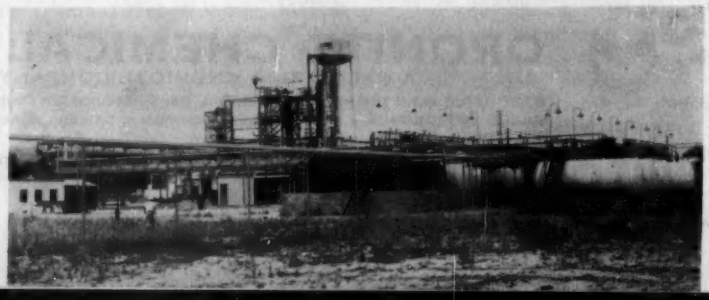
Oil layer, containing mixed butyltins, passes through a 10-ft. by 2-ft. bubble-cap tower which strips off solvent for reuse. Then, in a second, agitated, 1,000-gal. reactor, additional tin tetrachloride pushes the butyl chloride conversion to completion. Simultaneously, during the 5-hr. retention at 482 F., this reaction promotes the formation of dibutyltin dichloride from tetrabutyltin and butyltin trichloride.

A 20-ft. by 2-ft. bubble-cap column separates the dibutyltin dichloride from tributyltin chloride which becomes bis (tri-*n*-butyltin) oxide, a slimicide, fungicide and bactericide used in paper, textile and wood-preserving fields.

Granddaddy's Role—Organotin granddaddy (Oakley's designation) dibutyltin dichloride goes from the bubble-cap column to another 1,000-gal. reactor for reaction with NaOH at 194 F. for 4 hr. to form the hydroxide. Separation in basket centrifugal and drying produce dibutyltin oxide.

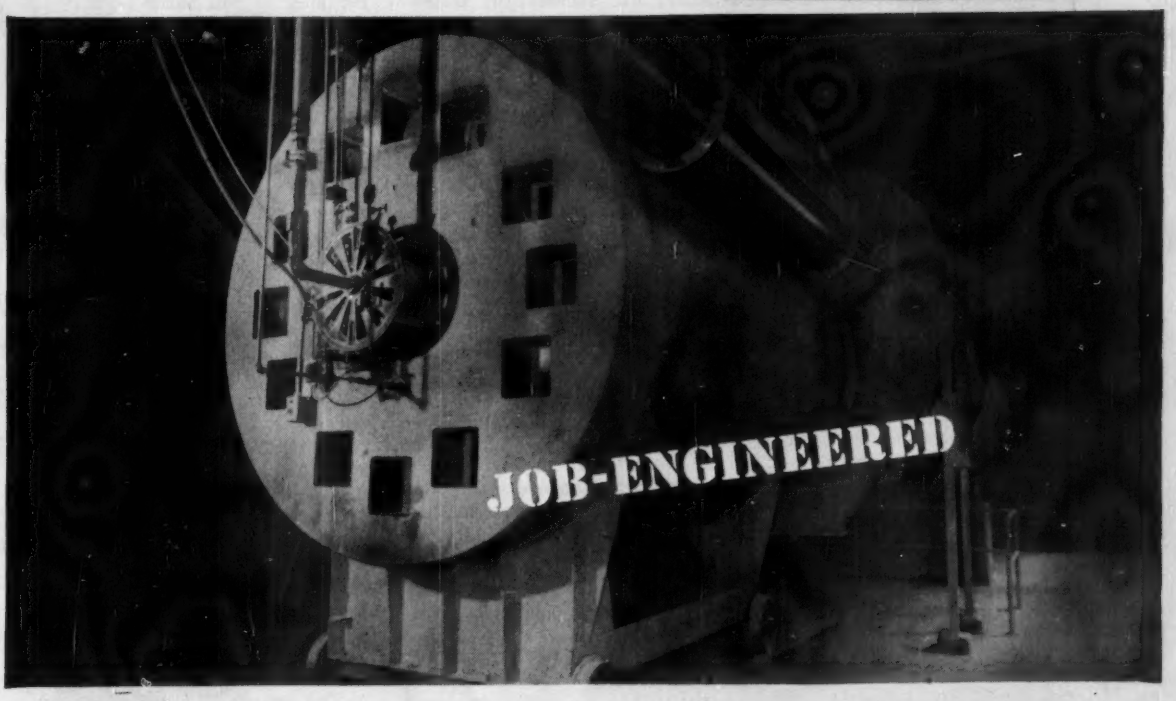
Various acids react with the

NEW GRASS-ROOTS PLANT turns out 19 different products.



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STANDARD HERSEY DRYERS





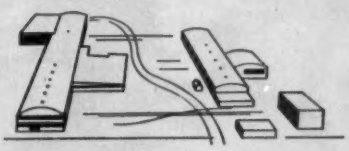
MINING FOR FOOD TO FEED THE EARTH— NEW CARLSBAD PLANT OF NATIONAL POTASH IS ON STREAM WITH STANDARD-HERSEY DRYERS!

Deep into the earth—1800 feet, deepest in the nation's potash industry—National Potash near Carlsbad, N. M., is mining for food to feed the earth, so that the earth will feed man better! Designed refinery capacity is 400,000 tons per year. And at the heart of this operation are 60-foot-long twin rotary dryers—*job engineered* Standard-Hersey dryers—designed and built by Standard Steel Corporation... a world leader in designing and manufacturing dryers, granulators, and coolers. Wide range and flexibility in Standard-Hersey dryers help you to produce almost any desired grade of fertilizer.

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STANDARD STEEL ACQUIRES LEADER IRON WORKS

SINCE Leader 1888

To meet the ever increasing needs of its world-wide customers, Standard Steel Corporation recently purchased the Leader Iron Works at Decatur, Illinois. Founded in 1888, Leader is well known for its work in the food, chemical and petroleum industries. In addition to its customary fabrication Leader will now manufacture Standard's line of heavy processing and road construction equipment.

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Midwest Offices & Plant **LEADER IRON WORKS** *Decatur 5, Illinois*

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oxide to form organotin derivatives mentioned earlier.

To manufacture tetraphenyltin, the aforementioned processing scheme is modified slightly. Use of monochlorbenzene, rather than butyl chloride, produces tetraphenyltin directly in the first reactor. Subsequent washing step produces oil layer consisting solely of tetraphenyltin product, which is used to stabilize unchlorinated transformer oils and as a polymerization catalyst.

Power-Applied Organic Film Saves Water

Water conservation moves forward another step as result of latest work in application of organic monomolecular films to water reservoir surfaces.

Using aqueous suspensions of octadecanol and hexadecanol, San Antonio consultant R. G. Dressler has successfully tested portable power-driven application equipment on a 40-acre reservoir near Eagle Pass, Tex. In an area where normal evaporation loss is as high as ¼ in./day, 40-60% saving of water was realized by use of protective layer.

On the basis of a 2,500-acre surface, Dressler estimates for the operation a total cost of $4.50/acre-ft. of water saved, with lower cost for larger reservoirs.

Continuous Analyzer Eases Alloy Determination

A continuous analyzer developed by Stanford Research Institute now determines sodium content in sodium-lead alloy in one step of Ethyl Corp.'s tetraethyl lead manufacture at Baton Rouge, La. Continuous analysis replaces former batch tests.

Key reactant of process is sodium-lead alloy containing 10% sodium. Composition must be known within ±0.01%. Former manual sampling, analysis and composition adjustment were difficult and time-consuming.

SRI's solution is potentiometric circuit with sodium-filled electrode submerged in the 400-500 C. molten alloy. Instrument measures potential change due to sodium activity. Potential is measured between electrical leads in the electrode and in sodium-lead alloy bath. Calibration of voltage vs. concentration reveals sodium content. With temperature compensation built in, the potentiometer reads directly in percent sodium.

Possibility exists for use in other liquid sodium and alkali-metal alloys.



New Lime-Processing Plant Vies for Western Markets

United States Lime Products Corp. has now brought on stream its $2-million lime-processing plant, above, at Arrolime, Nev., near Las Vegas. One of the largest plants of its type in the western U. S., the installation has twin preheaters and two 150-ft.-long rotary kilns, 10 ft. in dia. Each turns out 200 tons a day of quicklime. Plant was built by J. H. Pomeroy & Co.

Foamed Metals Studied As Smog Deterrents

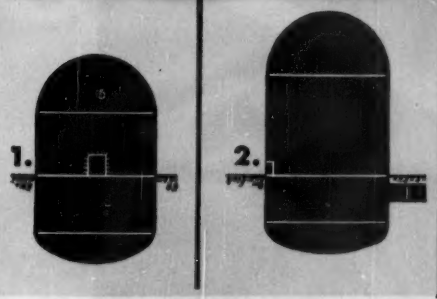
The search for clean air by Air Pollution Foundation (San Marino, Calif.) now turns to foamed metals (*Chem. Eng.*, June 30, p. 56) as possible smog preventive.

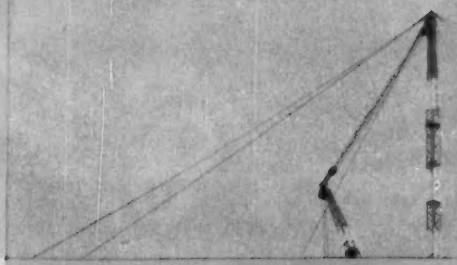
These "angel-food cake" materials—that "rise" from action of hydrogen released when a metal hydride is added to molten metal— will be studied under a one-year contract by Bjorksten Research Laboratories, Houston, Tex.

The foundation seeks only basic information about whether a foamed metal, when incorporated with a catalyst, can induce smog-forming hydrocarbons to burn in presence of lead salts. If so, catalytic afterburners in automobile exhaust lines might help clear the air.

After operating characteristics of foamed metals are determined, data will be made available to potential manufacturers.

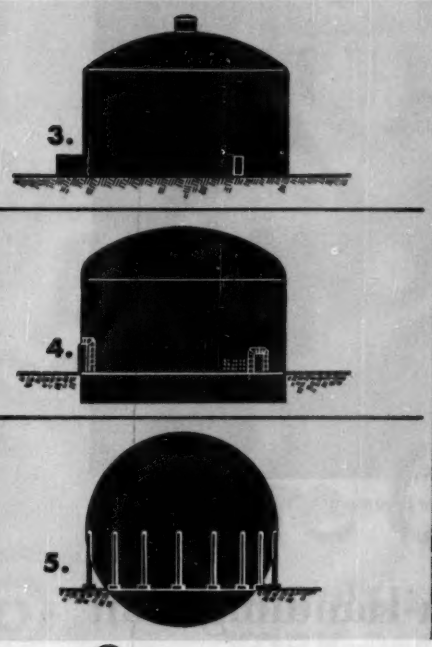
The foundation feels study is justified, since a lead-resistant oxidation catalyst may be economical solution to auto exhaust's large contribution to smog. A theoretical analysis of metal foams indicates they may serve as base for such catalysts.

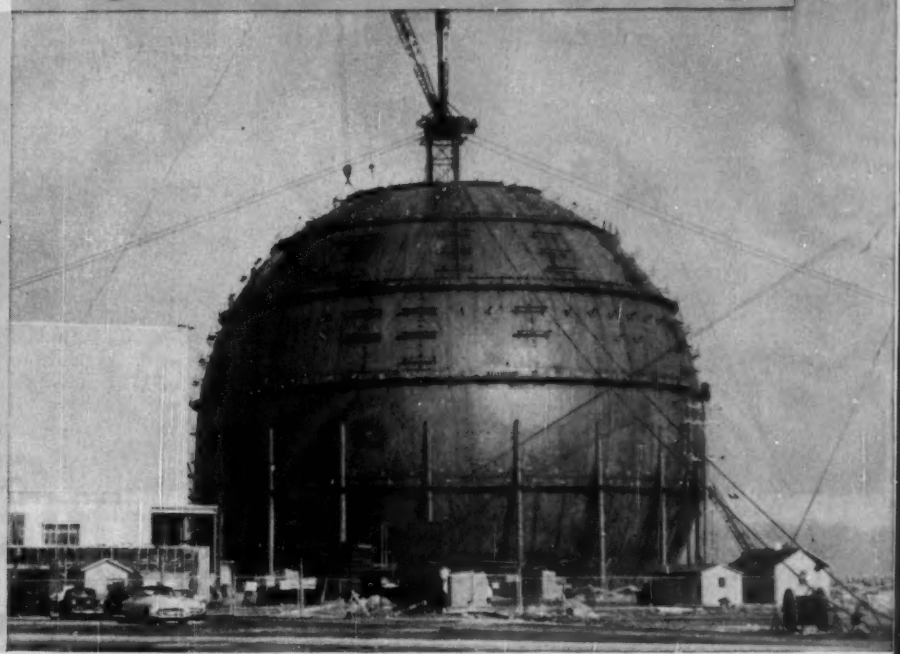




LAST PLATES GO IN AT DRESDEN STATION. 100-ton derrick with 170-foot mast lowers plates into place from 210-foot towers as 190-foot diameter Hortonsphere® nears completion at Dresden, Illinois Nuclear Power Station. CB&I-built structure will house atomic reactor. Station is a General Electric Co. project.

SHAPES OF things to come in the atomic age





CB&I Structures to Silhouette Major Reactor Projects

For CB&I engineers, fabricators and erection specialists, the challenge of things to come in the atomic age is, to a large extent, a reflection of existing accomplishments.

In 1954 the world's largest sphere, a Hortonsphere® measuring 225 feet in diameter, was built by CB&I for the AEC Knoll Atomic Power Laboratory at West Milton, New York, for testing a prototype of the atomic power plant which now serves our atom sub fleet.

Today, near Chicago, a skilled CB&I crew is completing the erection of a 190-foot diameter Hortonsphere to house an atomic reactor for the Dresden Nuclear Power Station. Near Detroit, another CB&I crew erected a reactor containment vessel of a different design for the Enrico Fermi Atomic Power Plant. Silhouettes of similar structures, being designed, fabricated or erected by CB&I, are shown here.

Yes, for CB&I, the shape of things to come in an atomic tomorrow had their beginnings *yesterday*. Experience gained in almost 70 years of furnishing *craftsmanship in steel* to serve Industry, Government and scientific research is now meeting the exacting requirements for reactor containment vessels.

1. Enrico Fermi Atomic Power Plant, Lagoona Beach, Michigan. (Power Reactor Development Co., Architect-Engineers)
2. U. S. Air Force, Dayton, Ohio
3. Atomic Energy Commission, Livermore, California. (Foster Wheeler Corp., Engineers)
4. Massachusetts Institute of Technology, Cambridge, Massachusetts. (John W. Cowper, Purchaser)
5. Dresden Nuclear Power Station, Dresden, Illinois. (Bechtel Corp., Constructor-Contractor)

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PANORAMA of data handling: typewriters (left), controls and alarms (center), equipment cabinet (background).

New Ethylene Plant Adopts Data-Handling Unit

Offering major operating improvements, Phillips' new data-handling system will lay basis for eventual change to computer-controlled operation.

Computational data processing now boasts a full-fledged, 400-point commercial installation in operation on Phillips Petroleum Co.'s new ethylene unit at Sweeny, Tex. Installed by Beckman Instruments, Inc., this Model 112 data-handling system will give Phillips the experience needed to determine where and how such systems should be used in future plants.

Because system is a pioneer venture for Phillips, it actually operates in parallel with control panel full of conventional recorders and controllers. However, since the data-handling equipment is fully transistorized, there is good assurance of maximum on-stream operation.

▶ **Does Many Things**—Phillips' installation scans signals from 400 instruments, logs the values periodically and gives alarm of upsets. Also, it totalizes flows to provide the accounting department with material balance information, corrected to standard temperature and pressure.

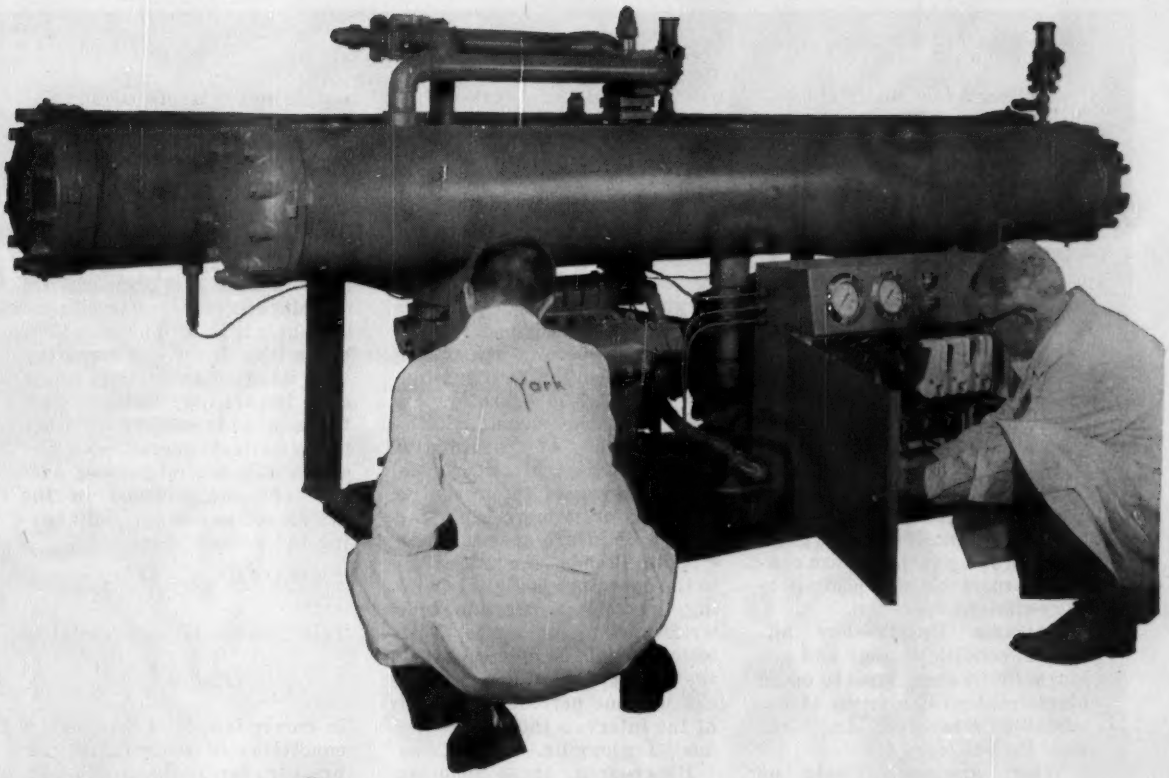
Other features permit operators to watch closely a limited number of variables during startup or to demand rapid and continuous logging of all variables during upsets.

▶ **Sets Up Computer Analysis**—In addition to use of these present functions of the data-handling system, Phillips plans to analyze the mass of accumulated data with a digital computer. By such analysis, Phillips will correlate process variables. Then, by computing accurate operating guides, company will improve plant operating efficiency.

Proceeding one step further, through process analysis, Phillips will gain accurate information which can be used to determine process equations. This will be the first step toward closing the control loop on the ethylene unit.

▶ **Final Move, Close Loop**—Carrying through from this first step to a final closing of the loop, a small digital computer can be added to the present system to work data through the process equations. Answers from the computations can be conveyed through electric-pneumatic transmitters to provide optimum set-points on key instruments every 1½ min.

Phillips' management feels that it will consider taking this step when the ethylene unit is operating close to full capacity.



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Controlling a few points at first, Phillips will gradually add more and more points until the entire unit is under automatic operation.

▶ **Present Operation**—At the moment, Phillips' data-handling system scans temperatures, pressures, flows and stream-analyzer outputs from 400 different points every 1½ min. Values are logged periodically at interval selected from choice of 3, 6, 15, 30, 60 or 120 min.

Automatic logging eliminates all manual logging operations, releasing operators to less-tedious, more-productive work. System gives more accurate information than human logging. Thus, process variables are controlled more closely, leading to more-efficient operation.

▶ **Pinpoints Upsets**—For off-normal conditions, high and low alarm limits are pinned in on an alarm pinboard in terms of the variable measured, i.e., psi., deg. F., bbl./day, etc.

When scanner detects an alarm condition, the alarm typewriter immediately starts printing out the off-normal values in red ink. At the same time, an indicator on the control console lights up to identify the trouble point. And, an audible alarm sounds.

Operator can obtain upset information rapidly by actuating a printout of all variables between scheduled periodic logging times. This provides valuable information on a continuous basis, while operators are correcting the upset. Subsequent study of information logged during this off-normal period may lead to preventive measures or to more rapid correction of future upsets.

▶ **Spots Trends**—An added aid to the operators is digital trending, whereby a separate typewriter prints out up to 30 selected variables, independent of the other system functions. This can be done periodically at any of the intervals indicated previously for logging.

By grouping these important variables in this fashion, the system makes trends readily apparent, forewarning of movements toward off-normal conditions.

This is especially valuable for watching tendency toward rapid change during start-up operations. During minor upset, all temperatures and pressures on a unit are under surveillance until unit is back to normal.

▶ **Handling Involves Computing**—In addition to scaling, offset and linearizing, system performs a wide variety of other mathematical operations. For example, a general-purpose analog computer included in the system solves computations having the general form

$$\frac{W/Q\sqrt{A[F(x) \pm B]} + S \doteq Y}{Z}$$

This formula is most useful as

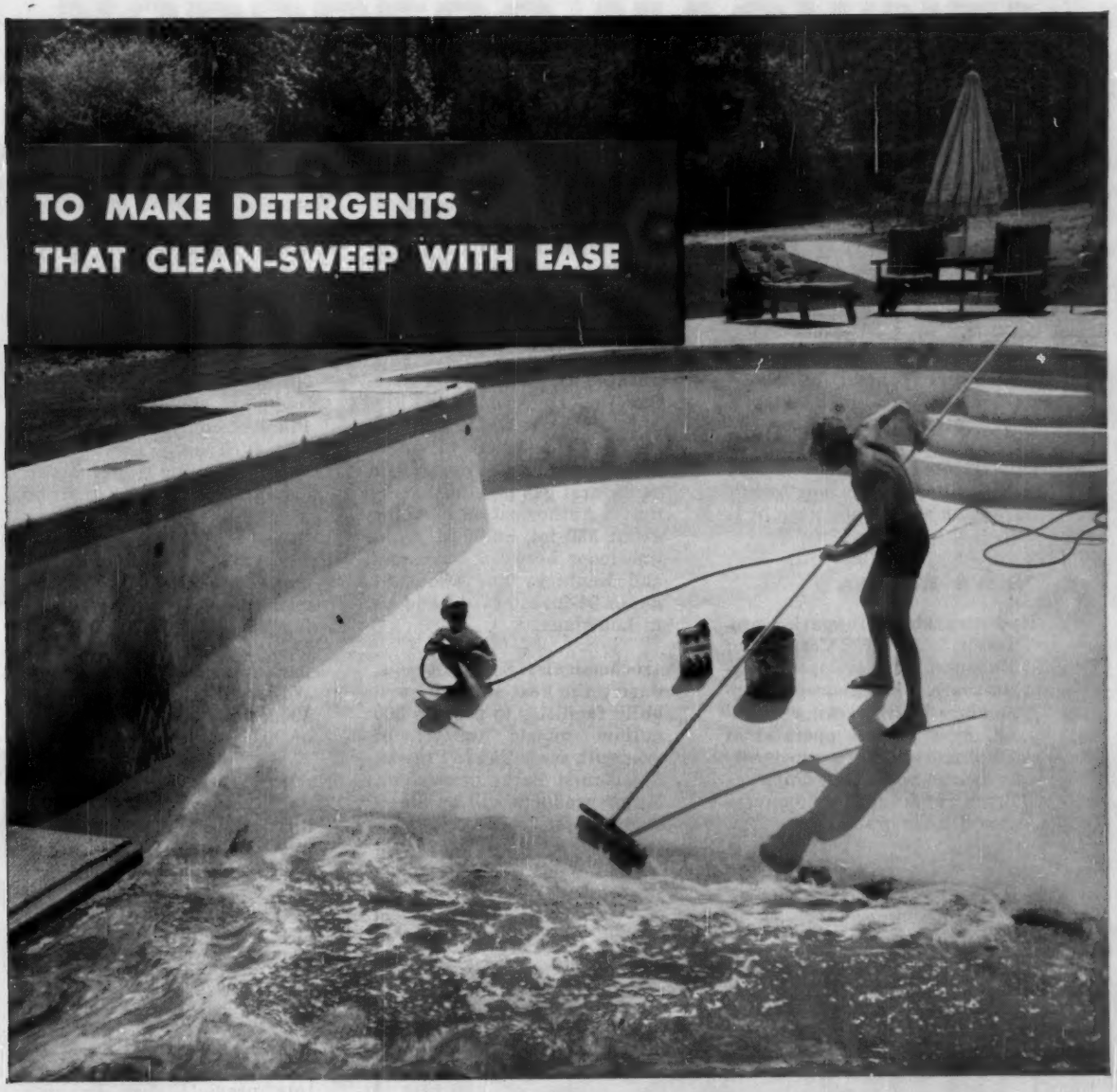
$$(P\Delta P)^{1/2}\frac{K\rho}{T}$$

in correcting flows to standard conditions of temperature and pressure for totalization.

(*Continued*)

DATA system's main equipment cabinet houses pinboards, visual indicators and modular function cabinets.





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System totalizes flows on a 24-hr. basis. Key flows are sampled at 1¼-min. intervals, scaled to bbl./day or lb./day, digitized and totaled to produce accurate information on material balance and throughput for accounting purposes.

▶ **Good Payout**—Choice of data-handling systems for future Phillips plants would save directly on the size of graphic panel and control room required. These savings added to those obtained through continuous optimum operation by a data system-computer-controller will result in a very worthwhile payout on such equipment, it is felt.

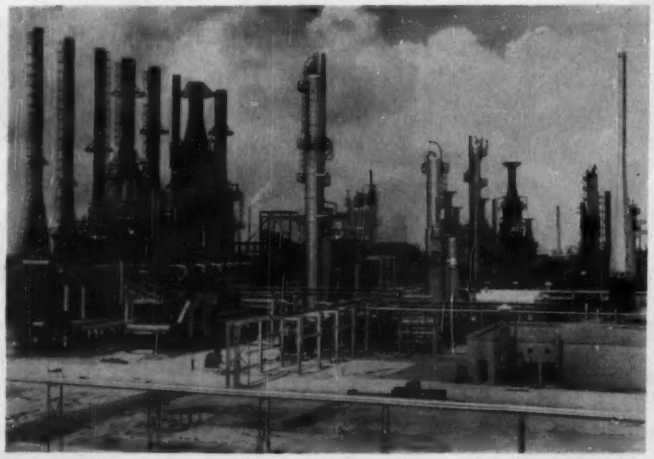
NEWS BRIEFS

Hydrocracking: Hungarian professor, Joszef Verga, of Budapest, has developed a low-pressure, low-hydrogen-consuming hydrocracking method. New process operates at 70 atm. and 440 C., reportedly consumes only one-third as much hydrogen as conventional hydrocracking.

Ammonium perchlorate: HEF Inc. is now constructing a multi-million-lb./yr. plant at Columbus, Miss., to produce ammonium perchlorate, used as oxidizer in solid propellants. Hooker Chemical Corp., one of the parent companies, will spend $1 million to expand sodium chlorate production capacity at Columbus.

Natural gas: Gulf Interstate Gas Co., Houston, Tex., has been authorized by Federal Power Commission to build and operate $51 million worth of natural gas pipeline facilities. Authorization is for about 352 mi. of 30-in. main line loops between Louisiana and Kentucky and about 54 mi. of 24-in. lateral line loops in Louisiana.

Petrochemicals: Soviet Russia, during the next 15 years, will build facilities to process 300 million metric ton/yr. of crude oil, according to Pravda, Communist Party newspaper. Major products will be diesel fuel and jet fuel.



Second Ultraformer Goes On Stream at Texas Refinery

Now on stream at American Oil Co.'s Texas City, Tex., refinery, a second Ultraformer will process 21,500 bbl./day. At left are eight in-line furnaces to heat charge to the unit.

Frasch sulfur: Freeport Sulphur Co. is now building a mile-long Y-shaped steel island seven miles off the shore of Louisiana in the Gulf of Mexico. Island is major part of a $30-million project to develop Grand Isle sulfur deposit.

Solvents: Imperial Oil Ltd. has now swung on stream a 600,000-bbl./yr. naphtha specialties plant at Sarnia, Ontario. Plant, according to Imperial, will turn out solvents with narrow boiling ranges, will displace about $2.5 million worth of imported products.

Refinery: Esso Petroleum, after two years of British government red tape, is now building its $50-million, 100,000-bbl./day refinery in a national park area near Milford Haven, Wales. On-stream date is late 1960, with initial throughput of 90,000 bbl./day.

Nuclear fuel: National Lead Co.'s Nuclear Metals Div., at its Magnus Metal Div. plant in Albany, N. Y., will manufacture nuclear reactor fuel elements. Firm will make flat-plate, pin and rod type metal and ceramic shapes from uranium and its alloys. Fuel elements will be clad with zirconium, aluminum and stainless steel.

Sulfur: Mexican Sulphur Institute predicts that Mexico's 1958 sulfur production may approach the 1.5-million-long-ton mark, compared with last year's output of somewhat over 1 million long tons.

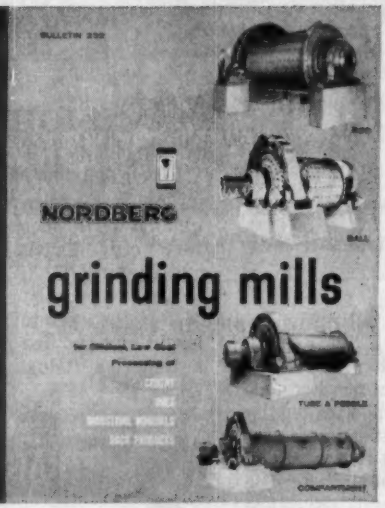
Refinery: Foster Wheeler Corp. has signed a contract with Petroleo Brasileiro S. A. for construction of a 90,000-bbl./day refinery near Rio de Janeiro, Brazil. Contract is expected to exceed $40 million.

Alkylate: Refinery Engineering of Tulsa, Okla., has been awarded contract for erection of a 2,300-bbl./day hydrofluoric acid alkylation unit at Carter Oil's Billings, Mont., refinery. On stream date is early 1959.

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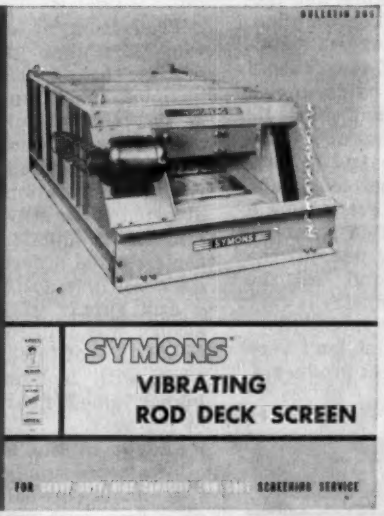
BULLETIN 232 describes the complete line of Nordberg Rod, Ball, Tube, Pebble and Compartment Grinding Mills built to meet specified conditions for wet or dry grinding in practically any process where friable material must be comminuted to fine sizes.



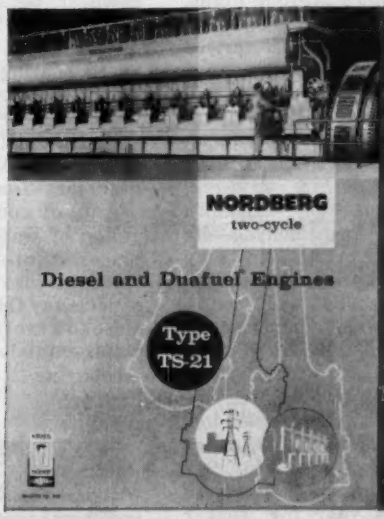
SYMONS® CONE CRUSHERS

BULLETIN 247 describes the various types of Symons Cone Crushers used in primary and secondary fine reduction crushing of ores and minerals. Leading producers have found these efficient crushers to be without equal in producing large tonnages at lo / cost.

SYMONS VIBRATING SCREENS



BULLETIN 265 describes the design and application of one of the many types of Symons Vibrating Screens and Grizzlies designed and built to meet requirements for positive screening with large capacity of accurately sized products . . . from primary scalping to extremely fine sizing.



NORDBERG ENGINES

BULLETIN 245 describes some of the typical Nordberg engines used for efficient, low cost power generation. Built in sizes to over 11,000 hp, Nordberg engines are available in two and four-cycle, in-line and "V" types . . . for Diesel, Duafuel® and Spark-Ignition Gas operation.

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Solvent Blues: It's Not Just the Recession

Maturing resin demands, formaldehyde-from-gas, protective-coating switches—all augur trouble for solvent markets.

Solvents get into so many uses that they have become a pretty good index of business. As such, they reflect the depressed activity of the national economy. But solvent makers have problems much more complex than this. They've got troubles which won't necessarily go away and hide when the economy perks up.

In general, alcohols and other solvents receded somewhat in 1957 from 1956's all-time highs, to about the level of 1955. It looks now as though there will be another decline this year.

Predictions point to over-all solvent business as being off at least 20%. Certain products, like methanol and the esters, may skid 30%.

Clue to most of methanol's troubles is formaldehyde—its biggest single outlet. Not only are formaldehyde-based resins, like the phenolic and pentaerythritol types, slumping in cadence with the building, automobile and textile industries, but, having probably reached their peak before the recession, they don't have too much further growth to look forward to.

▶ **Bypass Methanol**—Vying very strongly this year for weaker formaldehyde markets has been Celanese, the only major formaldehyde producer using direct oxidation of natural gas. So strongly, in fact, that methanol producers slashed prices up to 6¢/gal. recently in order to protect their formaldehyde-from-methanol interests.

Whether they can get methanol's price back up again soon remains to be seen.

▶ **Jolt from Detroit**—This year auto makers will make a move which will surely raise hob with markets for higher alcohols, esters and certain ketones. General Motors, encouraged by a 250,000-unit test run on its 1958 models, plans to switch its 1959 production 100% to acrylic lacquers. This will displace previously-used nitrocellulose lacquers which chew up large amounts of butyl and ethyl acetates, methyl isobutyl ketone.

The move to acrylics will, however, boost acetone and methyl ethyl ketone consumption.

Ford and Chrysler use alkyd-based coatings. If they should switch to acrylic paint, too, a lot of glycerine and phthalic anhydride will be out of a job—along with toluene and xylenes necessary for alkyd materials.

And, of course, every time a gallon of water-based paint replaces an oil-based one, all the solvents lose ground. So the expectancy that industry is very close to a truly first-rate outdoor water-emulsion paint isn't very reassuring to solvent producers.



This most recession-resistant solvent family will profit by the switch to acrylic lacquers in the auto industry.

Demand for the No. 1 ketone, acetone, was strong—(1957 output, 99 million gal.) throughout the year, inventories were low, and price structure was firm.

A good part of the acetone went into methyl isobutyl ketone whose output rose 8% over 1956 and now amounts to nearly 24 million gal. a year. MIBK made important inroads into markets for butyl derivatives (alcohol and acetate).

About the only market where MIBK lost ground was due to lower demand for vinyls in the automotive industry.



What with high-density polyethylene a little slow to catch on, there's a surfeit of ethylene for alcohol production.

Production of ethyl alcohol was 235 million gal. in 1957—5% less than in 1956. Depressed business conditions were part of the reason. But part of the production cut was deliberate—some alchohol producers, Union Carbide and National Distillers, diverted extra ethylene to polyethylene production. To fill all their alcohol orders they had to draw on inventories.

And supply of fermentation alcohol was limited—amounting to but 15% of total production—what with molasses having a higher value for cattle food most of the year.

▶ **Caught in the Middle**—With ethyl alcohol supply and demand just about in balance, prices were firm, with pressure for an increase overhanging the market all year. Yet despite this, one ethanol producer, concerned with keeping the price in line with the price of isopropyl alcohol (whose worth is figured at roughly 90% of ethyl's) felt the price of ethanol had gone high enough.

As long as cheap molasses is practically extinct—due to unsettled political conditions in Cuba and strikes in Hawaii—fermentation alcohol is expected to decline. Certain members of

A TECHNICAL MEMO FROM THE QUAKER OATS COMPANY ON

QO® TETRAHYDROFURFURYL ALCOHOL (THFA®) AS A SOLVENT

One of the important uses of QO THFA is as a solvent. A unique combination of properties makes this solvent outstanding. Note particularly: complete miscibility with water, high boiling point, and low viscosity. Its high flash point, low toxicity and water-white color are additional assets to be considered in the development of new coatings.

The table below lists various resins and their solubility in tetrahydrofurfuryl alcohol.

Solubility of Thermoplastic Resins In Tetrahydrofurfuryl Alcohol

(at room temperature)

Resin Type*	Solvent THFA
Cellulose nitrate	VS
Ethylcellulose	VS
Cellulose acetate	VS
Cellulose acetate butyrate	VS
Vinyl butyral	VS
Vinyl acetate	VS
Vinyl acetate-chloride	VS
Vinyl chloride	I
Vinyl-vinylidene chloride	SH
Nylon	I
Polyethylene	I
Methyl methacrylate	I, SH
Styrene	VS

S = Soluble from 1 g. to 10 g. per 100 g. solvent
VS = Soluble 10 g. or more per 100 g. solvent
I = Less than 1% dissolves within 6 days
H = Temperature of 70-75° C.; time one hour

Data from The Quaker Oats Company

*List of specific products tested available on request

As A Cleaner. Tetrahydrofurfuryl alcohol's solvent action on a wide variety of substances is utilized in various cleaning operations. For example, it is used in cleaners for nylon mesh of sport shoes, in formulations to remove lipstick stains and in the textile industry to remove gear grease from cloth. It is also useful in removing rosin solder flux and in cleaning brushes used to apply wetting agents.

In Coatings. Along with its high boiling point, miscibility with oils like linseed and soya, and compatibility with various pigments, THFA is useful in the paint industry as a solvent for lacquers, enamels, stain-filler and other coating compositions.

These Features of tetrahydrofurfuryl alcohol make it unusual as a solvent:

Flash point (Tag. open cup) °F 183
Freezing point, °C ..... −80
Boiling point, (760 mm) °C 178
No I.C.C. precautionary label

Check into tetrahydrofurfuryl alcohol by writing for a copy of our Bulletin 206. A sample will be sent when requested on your letterhead.

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CHEMICALS DIVISION

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In Japan:
F. Kanematsu & Company, Ltd., Tokyo

Congress still believe the government should release surplus grain at low prices. But it hasn't been demonstrated yet that this grain can be economically handled in this manner.

While ethylene production has been stepped up the new high density polyethylene hasn't made hoped-for progress. Consequently all synthetic ethyl alcohol producers will have enough raw material to produce all the ethanol that's needed, cover any loss in fermentation alcohol volume, and perhaps even export some at a favorable price.

Unfortunately, it looks now as though depressed business conditions will force a 10% cut in alcohol production this year and inventories will increase. And unless export demand does develop, look for a weakening of the domestic price level.



Market pressure from gas-derived formaldehyde forces methanol producers to slash postings nearly 20%.

Methanol production in 1957 was only 215 million gal.—off 11% from 1956. But this was pretty good considering general business conditions. Due to a slump in the building and automotive industries, demand for formaldehyde and pentaerythritol—plastics raw materials—was off enough to depress methanol production.

Additional capacity expected in 1957 didn't materialize when it was found that existing capacity could still take care of the country's needs.

▶ **Resins Still Slip**—Markets for formaldehyde- and pentaerythritol-type resins will continue to slip with the decline of the automotive, building and textile industries.

Fertilizers aren't expected to pick up enough to offset methanol losses in resins. (Ammonia can be produced, via some engineering changes, in a methanol plant.)

Methanol may be off as much as 30% in 1938—a situation which will probably persist for at least two years.



Isopropyl rides the acetone surge; amyls fade away; and Oxo alcohols are still waiting in the wings.

Isopropyl alcohol output rose 7%—to 190 million gal. This reflects growth of acetone production—up 6% in 1957 over 1956—and the increased demand for isopropyl, itself, as an anti-stalling additive.

No additional plant facilities were installed although Carbide did expand existing plant.

Other alcohols failed to keep pace in 1957 with the general demand for solvents. Part of the decline stems from lower demands from the heavy goods industry. But some can be attributed to changes to the types of finishes which use more ketones and less esters (See automobile-lacquer shift on p. 90).

Supply of *n*-butyl alcohol slipped 23% for two reasons: There was only one producer, Carbide, the greater part of the year; and the MIBK surge mentioned above.

n-butyl lost more ground to isobutyl alcohol, as producers of both solvents priced isobutyl—always tough to move—at a level which gave better value than quoted price for normal butyl.

Markets for amyl alcohols declined to the point where they are now limited to specialty use. Apparently amyl cannot be made at a price which will compete with butyl, with the result that substitutes have been developed for it in protective coatings.

Several new Oxo alcohols, announced during 1956, were expected to be competitive in 1957. But demand didn't develop as expected; higher alcohols have yet to feel competition from the Oxo process.

Solvent End Uses Show High Stakes in Coatings

ETHYL ACETATE

	%
Lacquers	70
Vinyl adhesives	11
Celluloid	9
Export	3
Misc.	7

BUTYL ACETATE

	%
Coatings	78
Solvents	6
Adhesives	5
Export	3
Misc.	8

ACETONE

	%
Derivatives	45
Paint & varnish	20
Methyl methacrylate	10
Drugs & misc. chemicals	10
Rayon	4
Epoxy resins	2
Misc.	9

METHYL ETHYL KETONE

	%
Vinyl lacquers	30
Nitrocellulose	19
Plastic & rubber coatings	18
Lube-oil dewaxing	8
Adhesives	18
Export	5
Misc.	2

METHANOL

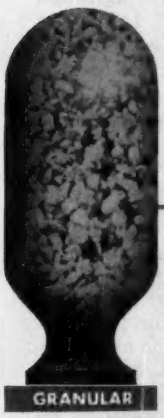
	%
Formaldehyde	45
Chemical derivatives	16
Fuel	12
Antifreeze	9
Solvents	7
Export	2
Misc.	9

ETHANOL

	%
Acetaldehyde	55
Other chemicals	16
Proprietary solvents	10
Cleaning, preserving	6
Food and drugs	5
Toilet preparations	3
Lacquer & plastics	3
Export and govt	2







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DEVELOPMENTS . . .

CHEMICAL PRODUCTS EDITED BY FRANCES ARNE



Herbicide

2,4,5-T product formulated in invert emulsion cuts spray drift.

A new 2,4,5-T herbicide has been formulated as an invert emulsion—a dispersion of oil particles in water—to cut spray drift hazard to a minimum. Possibility of herbicide vapors causing damage on adjacent land is cut further because product is a non-volatile, free acid formulation.

Called Inverton 245, it has a thick creamy consistency, is sprayed on vegetation in large particles and does not break into a mist. It clings tightly to branches and foliage permitting spray crews to work in wet weather when other herbicides cannot be used.—**Dow Chemical Co., Midland, Mich. 94A**

Paint Vehicle

Resin emulsion can be complete vehicle or modifying agent.

Designated W-617, a new anionic emulsion of a hydrocarbon copolymer resin is prepared from monomers selected to provide both maximum binding properties and compatibility with latex materials used in emulsion paints.

Vehicles that are 100% W-617 surpass the scrubbability requirements of Federal Specification TT-P-29. Formulation of W-617 and other latex base materials meet high quality standards for scrubbability, flexibility and freeze-thaw, at a raw materials cost far below the cost of latex materials used alone.

When used in place of alkyd resin emulsions, as a modifying agent, it provides greater scrub-resistance at less cost.

Used with acrylic or styrene butadiene latexes, it is said to give emulsion paints improved leveling and brushing properties without adding the detrimental properties common to other modifying agents.—**Velsicol Chemical Corp., Chicago, Ill. 94B**

Textile Softeners

A silicone, an emulsifiable polyethylene, a cationic softener.

A new, non-ionic silicone emulsion has been designed specifically for softening high quality thermosetting finishes.

Called XLE-48, it is not a textile water repellent. Tests have shown that water repellency is accompanied by resoiling during washing. By elimination of the water repellency feature usual with silicones, the manufacturer has achieved a durable softening agent that minimizes wet soiling and maintains optimum drying rates.—**Union Carbide Corp., Silicones Div., New York, N. Y. 94C**

An emulsifiable polyethylene sold under the name A-C polyethylene 629 is said to overcome loss of hand and tear strength when used in conjunction with thermosetting resins in the finishing of wash-and-wear garments.

Inherent advantages of the softener, recommended for both natural and synthetic fibers: High melting point which makes it wash stable and dirt resistant at normal wash temperatures, non-chlorine retentive, non-nitrogenous, sunlight and scorch resistant. — **Allied Chemical Corp., New York, N. Y. 94D**

A cationic softener is said to add a soft, lubricated and pliable hand to cotton and synthetic fibers and to resist yellowing when exposed to atmospheric oxides of nitrogen.

Marketed as Avitex Q, the compound is a soft, smooth white paste that disperses readily in water with agitation at temperatures of 140 F. or higher.—**Du Pont Co., Wilmington, Del. 94E**

Potassium Sorbate

Available from two new sources for food use.

Both Pfizer and Union Carbide Chemicals have announced commercial availability of potassium sorbate for use as a fungistatic agent for foods.

Carbide intends the new product to complement Sorbic, its refined sorbic acid. It will fill needs of food processors requiring a fungistat that is more water-soluble than Sorbic.—**Union Carbide Chemicals Co., New York, N. Y.**

From Pfizer's brand of potassium sorbate, called Sorbistat-K, up to 40% solutions can be prepared simply by dissolving in water.—**Chas. Pfizer & Co., New York, N. Y. 94F**

Plastic Pavement

Epoxy paving resin features safety.

A new safety pavement made of plastic resists skidding when it is wet. And it stops cars in half to three-quarters of the distance required by cars stopping on concrete.

The material is a plastic adhesive. Called Guardkote, it grew out of Shell's research in Epon resin which led to a cooperative road surfacing program with Reliance Steel Products Co.

It is poured on a conventional

NEW from Standard Oil

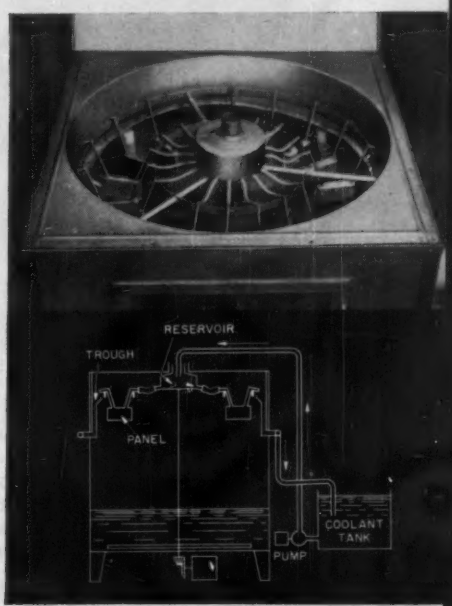
THE MAGIC BOX

Corrosion steals $5.5 billion from industry annually. Standard Oil is in the forefront of the fight to control this loss. Standard's research scientists have developed a new method for measuring the effectiveness of rust preventives. This new test takes less than one-twentieth of the time of previous tests—and is about three times as precise.

Using a controlled humidity cabinet for testing corrosion, these Standard research men installed a system for cooling metal test panels (previously treated with rust preventive) so that their surface temperatures are lower than the temperature in the cabinet. Temperatures of panel surfaces and of cabinet atmosphere are held accurately. Controlling the temperature of the panels controls the rate at which water condenses on them. This in turn (for the first time) permits accurate control of the amount of condensation on the panels. Rust preventives are more speedily and precisely tested. Science, as a result of this work, has a new tool with which to test corrosion.

This is the research pay-out industry receives from Standard Oil. This is the something extra that backs up the Standard industrial lubrication specialist who calls on you. This is the something extra found in the products he sells.

To know more about how Standard Oil industrial lubrication specialists—and Standard's research program—can help you, call the Standard Oil office nearest you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.**



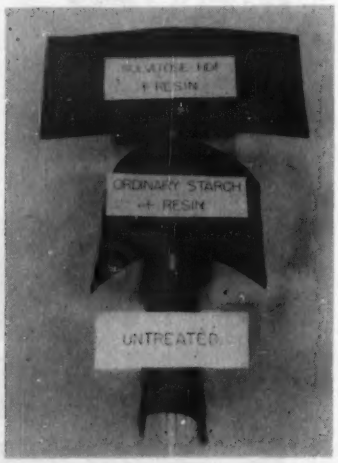
Top view and cross section of Accelerated Condensation Corrosion Test cabinet.

You expect more from STANDARD and get it!



Edgar A. Dieman, Standard Oil scientist, inventor of new Rust Preventive System, inspects metal panel that has undergone test in the humidity cabinet.

road surface—either concrete or asphalt—and covered with grit as it begins to harden. The result is a thin, sand-like coating stuck firmly to the road.—**Shell Chemical Corp., New York, N. Y.** **94G**



Textile Finish

Etherized starch-resin suffers only 8% loss in three washings.

In recent comparative tests, an etherized starch finish called Solvitose HDF suffered only an 8% loss after three washings of the finished fabric in a solution containing dry bleach. A number of finishes incorporating ordinary starches and starch derivatives had a loss of at least 39% in the same number of washings.

Designed for cotton and synthetic fabrics, the starch is cold-water-soluble. It is said to cut time and costs in preparation of the finishing solution. The bath requires no cooking and subsequent cooling. Only agitation is needed as the starch ether is added.—**Morningstar - Paisley, Inc., New York, N. Y.** **96A**

Colloidal Graphite

High quality solid lubricant.

Described as the first high quality, high purity, finely stabilized natural colloidal graphite ever produced in the field of solid lubricants is newly-introduced Suspension 10. It was developed for high temperature, severe load industrial lubrication applications.

Field tests have shown it to have practical value in glass mold lubrication, forging and die casting; forming, stamping and drawing aluminum, titanium, etc.; oil additive for internal combustion engines; oil and grease blending.—**Joseph Dixon Crucible Co., Jersey City, N. J.** **96B**

Polypropylene

Fabricators line up: A yarn and a rope manufacturer start use.

A leading textile manufacturer has started commercial production of polypropylene monofilaments and multifilaments in a range of sizes, shapes and colors. Company expects to find customers among manufacturers of rope, wet and dry filter elements and of many fabrics for which nylon, Saran and polyethylene fibers are used.—**Reeves Bros., Inc., New York, N. Y.** **96C**

A step nearer the consumer, a leading rope producer has added polypropylene rope to its line. Company describes it as significantly stronger, longer wearing, more heat resistant and less slippery than polyethylene rope. An outstanding quality is high strength per unit weight which it fully retains under wet conditions, unlike most synthetic ropes.—**Plymouth Cordage Co., Plymouth, Mass.** **96D**

Nitrogen Compounds

Potential in pharmaceuticals, organic synthesis, solvents.

Availability of four new nitrogen heterocyclics has been announced: n-butylene pyrrolidine; n-methyl pyrrolidine; 3,5-dibutyl pyridine and 3,5-dimethyl pyridine. All four undergo reactions typical of tertiary amines.

Potential applications of n-butylene pyrrolidine and n-methyl pyrrolidine are as pharmaceutical and chemical intermediates. The former is available in pilot plant quantities and stocks are adequate to supply development interests.

N-methyl pyrrolidine is available in 55-gal. drums, five- and one-gallon cans as well as in one-pound bottles.

One compound, 3,5-dibutyl pyridine, has a wide temperature range which suggests possible use as a heat transfer medium. Its high percentage of aliphatic carbons also suggests lubricity properties.

Potential uses of 3,5 dimethyl pyridine include solvent uses and organic synthesis. The chemical can be readily oxidized to dinicotinic acid. Both pyridines are available in research quantities.—**Ansul Chemical Co., Marinette, Wis.** **96E**

Briefs

Shut-down polyethylene, a special temperature - resistant form of the compound has been developed to purge polyethylene extrusion and injection molding machines of normal resin during shut down. Object of the new compound, called Petrothene 205-1, is to combat thermal degradation which causes post-start-up scrap.—**U.S. Industrial Chemicals Co., New York.** **96F**

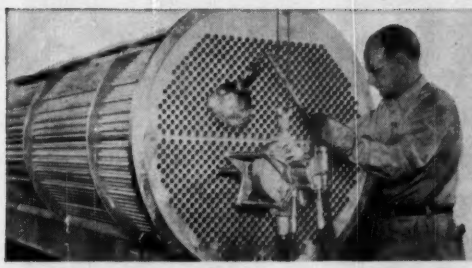
Structural surfacing material called Permatop is said to be harder than concrete, to resist industrial corrosion and to literally weld to new or old masonry. Mineral aggregate and plastic binder are provided in a single package.—**Permagile Corp. of America, New York, N. Y.** **96G**

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p. 193)



CONDENSER AND HEAT EXCHANGER CLINIC

Edited by David S. Hibbard, Metallurgical Engineer
The American Brass Company, Buffalo 5, N. Y.

Duplex Tubes handle dual corrosion problems —or unusual pressure-temperature conditions

Anaconda Duplex Tubes are special-purpose products designed primarily to meet requirements involving dual problems of corrosion. They are usually made by drawing tubes of copper or a copper alloy either inside or outside of steel tubes. However, they can be furnished in any combination of components, including copper or copper alloys with other nonferrous metals or steel, in a wide range of diameters and wall thicknesses.

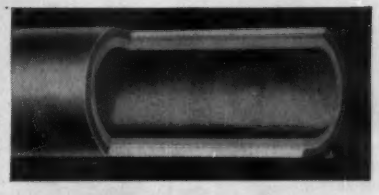
A Duplex Tube of steel with copper or a copper alloy inside is used, for example, in exchangers or condensers handling water in the tubes and ammonia or a fluid with appreciable amounts of ammonia in the shell. Moist ammonia attacks copper and all of its alloys, and may cause stress-corrosion cracking. Steel, however, is not susceptible to such action by ammonia. Thus, the nonferrous tube is shielded and can perform its normal function of giving long service life and efficient heat transfer on the "water side."

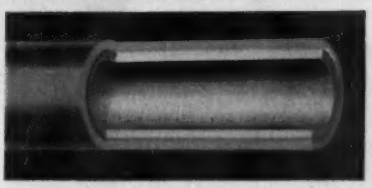
Other combinations of coolant—or heating fluid—and "stream" are found in petroleum refineries and chemical plants, in which differing properties are required inside and outside an exchanger tube. Here, two nonferrous metals may be combined—a Cupro Nickel and Admiralty, for example.

For extra strength. Anaconda Duplex Tubes can also be used in those applications where internal or external pressures—or the pressure-temperature combinations—are too great for a nonferrous tube alone. In this case, the nonferrous tube is selected for the chemical properties required for the more corrosive fluid handled; and the steel tube gives the needed strength.

Heat transfer properties. The fabricating method by which Anaconda Duplex Tubes are manufactured assures a tight mechanical bond between the outer and inner components of the tube. This tight mechanical bond assures no significant loss of heat transfer across the interface between the two components of the duplex tube. With duplex tubes, copper and steel or copper alloy and steel, the heat transfer will be definitely superior to that of a solid steel tube of the same total wall thickness regardless of which metal is inside or outside.

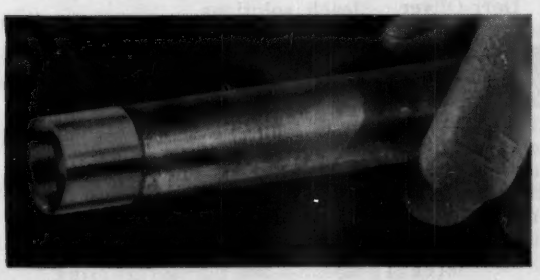
U-bends. The compact U-bend tube design in heat exchangers has many advantages, particularly where wide temperature differences exist in the unit. And Duplex Tubes can be readily bent to form the hairpin or U-bend tubes required—in the longer lengths now becoming increasingly popular.





Duplex Tubes are made by drawing copper or copper alloy tubes either inside or outside of steel tubes—or of tubes of a different copper alloy.

Technical Assistance. Specialists at The American Brass Company are constantly working with manufacturers and users of heat exchange equipment, helping to solve process problems. This experience is available to you. For more detailed information on Duplex Tubes, U-bend Tubes, address: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

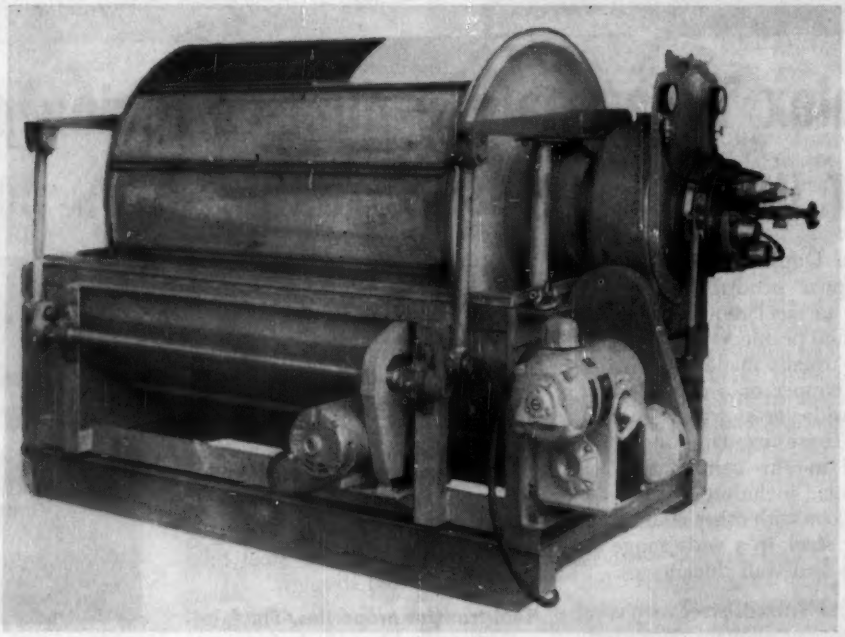


Duplex Tubes can be furnished with the outside tube cut back to be replaced by a ferrule of the same composition as the inside tube—to avoid galvanic corrosion.

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TUBES and PLATES for CONDENSERS & HEAT EXCHANGERS

Made by THE AMERICAN BRASS COMPANY



Rotary Filter Boasts Plastic Construction

Lower capital expenditures, coupled with scale-inhibiting and corrosion-resisting characteristics, invite broad application for new filter.

Is there an economical niche in the process industries for a rotary-drum vacuum filter fabricated from plastic—one that can stand up under corrosive and scaling conditions?

Apparently Dorr-Oliver Inc. thinks so, because it's just put one on the market. According to A. C. Barnebl of the Filtration Technical Div., "We expect its performance to be equal to, or better than stainless or rubber-covered machines of comparable size and design—and at a lower all-around cost."

Culminating over a year's development, the new filter features a molded glass-fiber-impregnated resin construction. As such, it's claimed to be the first plastic rotary filter commercially available. Reports from Dorr-Oliver's subsidiary in France indicate that they too have built a plastic filter (polyvinyl chloride construction), but that it's still in the experimental test stage.

▶ **Applications, Limitations**—Since all vital filter surfaces contacting filtrate or cake are either plastic or plastic-protected, the new Dorr-Oliver unit is immune to many corrosive media, at temperatures up to 170 F. Exceptions include highly concentrated caustics and highly oxidizing acids.

Another welcome asset of the filter is its scale-inhibiting characteristics, attributable to the smooth, slippery surface of the plastic. Solutions such as saturated lime salts, synthetic rubbers and silicates sometimes tend to scale out on working parts of metallic filters, thus proving detrimental to efficient operation. According to the manufacturer, scaling doesn't readily occur in the plastic machine—maintenance cleaning and its costs are thus cut to the bone.

As testimony of its versatility, the prototype filter has shown excellent form on test at a large uranium mill in the Southwest, where it separated leached residues from acid leach solutions.

▶ **Low Cost, Weight**—Dorr-Oliver doesn't expect its filter to compete with unprotected mild steel machines. True, it could handle any filtration job under 170 F. just as well, but its cost is 15-30% higher. On the other hand, however, the plastic-filter investment runs only about ⅔ that of a rubber-

MULTI-Pak AIR FILTER OFFERS YOU A MEDIA CHOICE, FOR THE EFFICIENCY YOU WANT!





MORE THAN 50 SQ. FT. OF MEDIA IN ONE UNIT. Renewable media is shown here being placed on one of the seven metal inserts that fit into the "pockets" of the MULTI-Pak unit. One 2′ x 2′ x 22¾″ unit contains more than 50 sq. ft. of media.



PERMANENT FRAMES MAKE MEDIA SERVICING SIMPLE, INEXPENSIVE. Here is a loaded insert being placed into a MULTI-Pak "pocket". The insert snaps into place behind retainer and forms a positive seal against air leakage. Permanent frames insure easy, inexpensive servicing.

A new high in filter versatility!

HERE'S news from AAF—multiple-media MULTI-Pak, the most *versatile* mechanical filter made. This AAF product was specially designed to offer higher air cleaning efficiency, higher dust-holding capacity in a mechanical filter.

The dry-type MULTI-Pak takes a wide variety of renewable media materials, offers a wide range of efficiencies—all the way from plant pollen to tobacco smoke—even on extremely high-temperature jobs! There are more than 50 square feet of media in the seven "pockets" of one 2′ x 2′ x 22¾″ unit—*thirteen times* more media area than face area. Permanent media frames insure a perfect seal . . . make media servicing simple and inexpensive.

Get all the facts on this amazingly versatile filter. For complete MULTI-Pak information, call your nearest AAF representative or write direct for Bulletin No. 237.

AAF Dust Control Equipment





Illinois Heating Specialties

AAF American Air Filter COMPANY, INC.

herman nelson

326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

BETTER AIR IS OUR BUSINESS

AAF Filters and Precipitators





Herman Nelson Industrial Heaters

covered unit; this is the big selling point.

In addition, transportation and rigging savings help to beat down initial costs even further. These savings are directly attributable to the filter's weight, which is only about 75% that of a comparable steel unit.

▶**More About Construction**—The new machine is essentially all plastic. Only a few structural members are steel or steel-reinforced.

For instance, the drum, trunion and drum heads are all of molded-resin construction. So is the filter's tank. Even the bearings are protected with plastic; each consists of a steel bearing surface molded into a plastic body. Major non-plastic parts include, for obvious reasons, such items as tank supports and the drum shaft.

An added feature that boosts drainage rates is a new type of cloth support—molded rubber grids, waffle-like in appearance. For inspection and cleaning, these grids snap into and out of the longitudinal sections of the drum's surface.

Filter operations, including pickup, washing and discharge, are the same as those of standard models. And speaking of discharge, the new unit comes with either rubber or synthetic scrapers, stainless steel wire, or a nylon string-discharge arrangement.

▶**Vital Statistics**—Dorr-Oliver's plastic filters are now available in several sizes, covering a range of filtering areas from 9 to 100 sq. ft. Models come in 3-ft.-dia. drums by 1-, 2-, 4- and 6-ft. faces; and 4-ft. diameters by 2-, 4-, 6- and 8-ft. faces.—**Dorr-Oliver Inc., Stamford, Conn.** **98A**

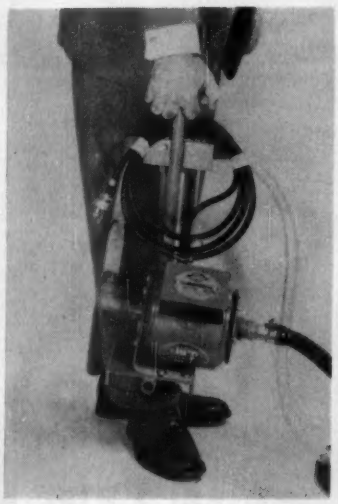
Homogenizer-Disperser

For production applications in size reduction.

The Polytron, a new mechanical device for mixing and wet-milling, is designed to provide high-speed particle reduction to the micron and sub-micron size range.

The self-cleaning milling head consists of a precision ring-within-a-ring set of shearing blades. In operation, the inner ring spins at speeds to 18,500 rpm., thus submitting the materials in process to shear, impact and cavitation forces that provide the desired homogenizing-dispersing action.

Polytron is available in four sizes; these cover a batch proccessing range of ½ pint to 2,500 gal.—**Bronwill Div., Will Corp., Rochester, N. Y.** **100A**

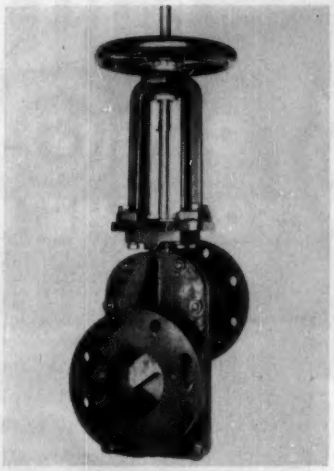


Solution Filter

Portable unit polishes precious liquids.

Especially designed for the clarification of precious-metal, pharmaceutical and biological solutions, the Pre-Met solution filter uses a canned turbine pump assembly to minimize product loss and contamination. A stainless steel tube contains the filtering medium—a cartridge consisting of cotton or Dynel yarn wound around a stainless supporting core.

Change of cartridge characteristics enables variation of removal effectiveness over a particle-size range of 1 to 150 microns. Supplementary filter tubes increase filtration area by multiples of 500 sq. in. each; flow rates vary from 300-800 gph., depending on the total filtration area.—**Sel-Rex Corp., Nutley, N. J.** **100B**



Slurry Valve

Added to line of flow control equipment.

Design features of the handwheel-operated Ratogate valve are claimed to assure reliable, non-plugging performance during flow control of pulp stock and other slurries. According to the manufacturer, the Z-shaped body creates a controlled turbulence that keeps particles in suspension, and a diamond-shaped port prevents plugging at small valve openings.

Available with either an iron or stainless steel body, and stainless gate and stem, the valves come in sizes from 3 to 12 in., with flat-face ASA flange drilling.—**Fischer & Porter Co., Hatboro, Pa.** **100C**

Salt Dissolver

Provides brine at low initial and operating costs.

Three equipment items for dissolving rock and evaporated salt are now available to industrial users of brine. Designed to provide automatic flow of high-purity, saturated brine, the Brinemaster features simple operation, small installation space requirements, and no agitation or circulation other than that provided by incoming feed water.

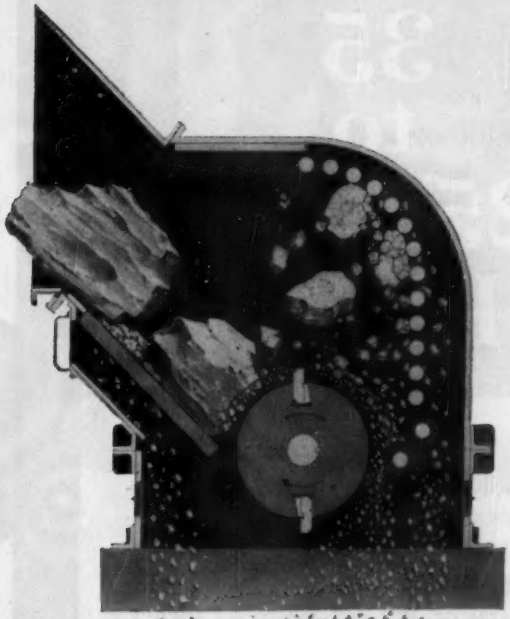
(*Continued on p.* 172)

FOR GREATEST

POSSIBLE

REDUCTION

IN ONE PASS...



THE JEFFREY ROCK BUSTER



24-inch carbon electrodes, 6 feet long, have been fed to this Rock Buster for seven years. Plant engineers are "amazed" at its continued fine performance.



Carbide, always a difficult material to handle, is literally *exploded* by impact in the Jeffrey Rock Buster and made ready for further processing.

Superior in performance and economy, this hard-hitting giant with its high speed impeller bars strikes the material in suspension . . . continues to wallop it until it's broken down to the desired size.

Feed the Rock Buster large, friable, non-abrasive materials and they're quickly reduced to a product of market size. (No wet or sticky materials; that's a job for the Jeffrey Mud Hog.) Size of finished product can be adjusted to meet your various requirements.

Crushing elements are made of manganese steel, enabling them to stand up in the toughest service. For a copy of Bulletin 854 describing the Rock Buster, write The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.

JEFFREY

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35 to 25,000 GPM/LP*

In the rapidly expanding chemical field, essential water supply for operations and transfer is met by Layne Vertical Turbine Pumps.

Whether the supply or the demand calls for a 4 inch well or any size up to 42 inches, Layne Pumps are designed and engineered to deliver the required GPM economically and unfailingly.

Pioneers and acknowledged leaders in the field of water, Layne produces pumps designed to meet multiple service requirements efficiently and economically.

*/LP—Per Layne Pump

LAYNE & BOWLER, INC., MEMPHIS
GENERAL OFFICES AND FACTORY • MEMPHIS 8, TENN.
LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

Layne

WATER WELLS • VERTICAL TURBINE PUMPS
WATER TREATMENT

To: Layne & Bowler, Inc.
Memphis 8, Tennessee

Gentlemen: Please send me bulletin No. 100.

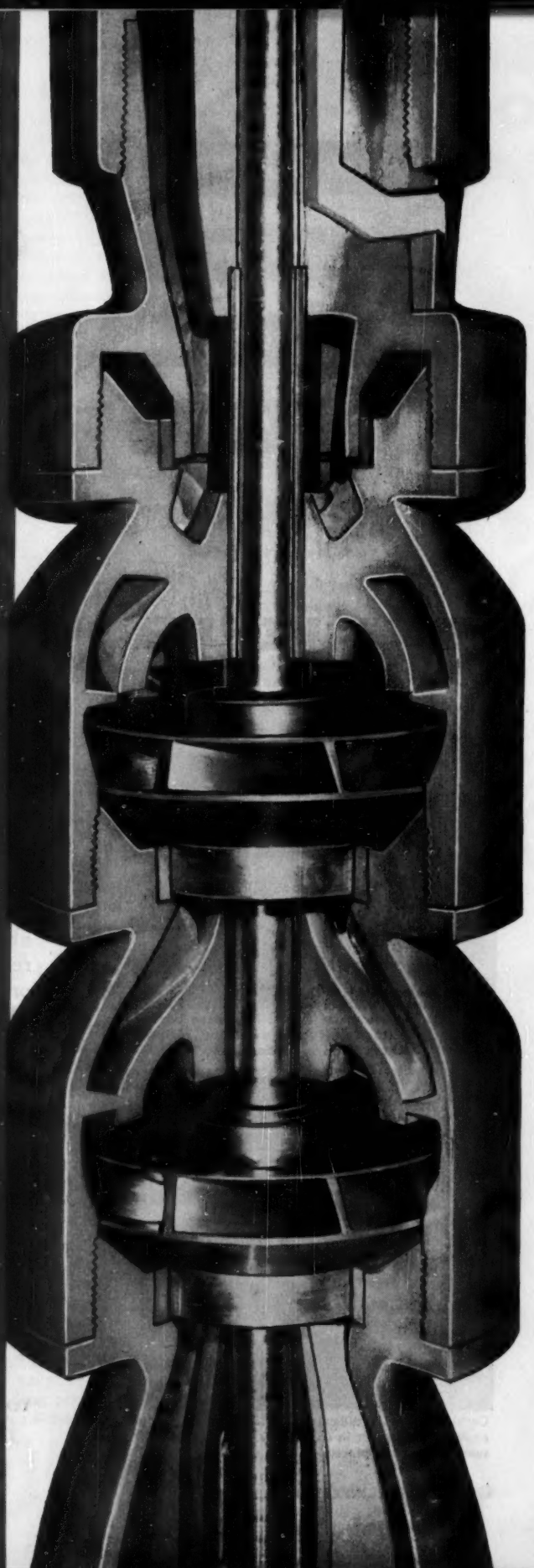
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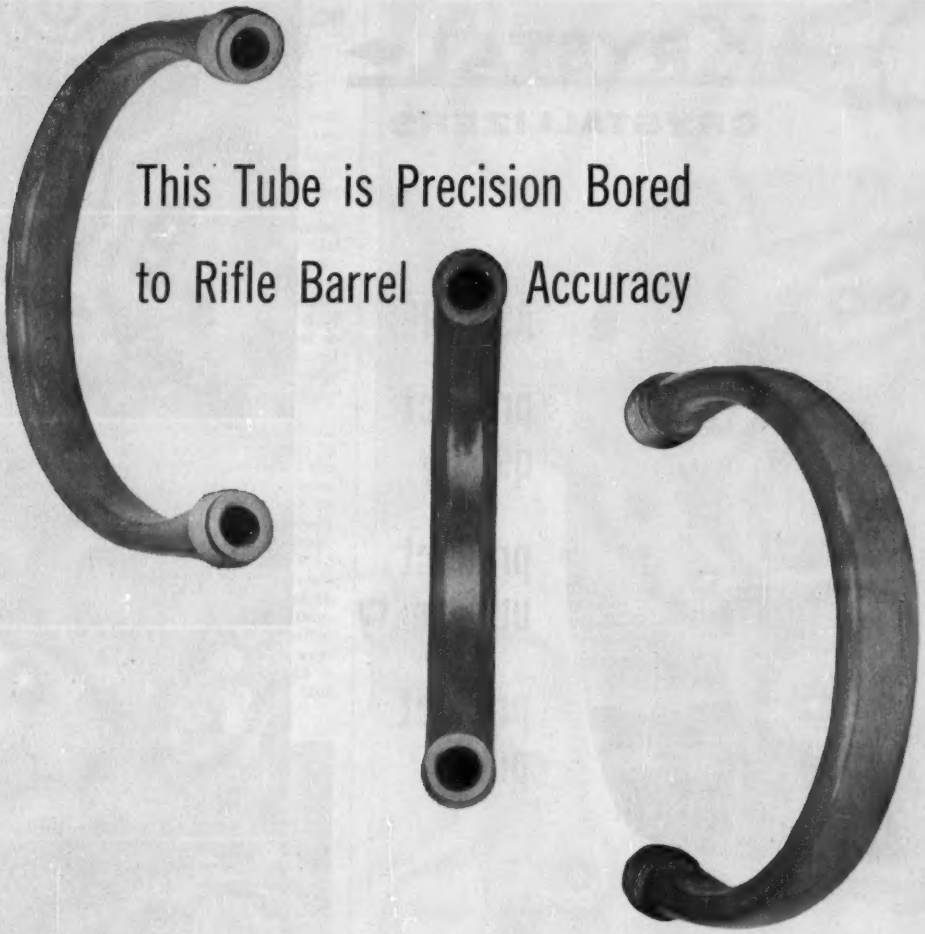
*Organization*_____

*Address*_____

*City*_____ *State*_____



This Tube is Precision Bored to Rifle Barrel Accuracy





Ashcroft Duragauge in Phenol case — a tough, rigid plastic turret type case for wall or flush mounting.

The Bourdon tube in Ashcroft Duragauges is machined mirror-smooth inside and finish ground outside to exact tolerances. Strong, uniformly thick walls assure precise flexibility—sustained high accuracy and long life.

Eight tube materials permit you to select the best metal with sensitivity balanced by internal corrosion resistance. Whether your choice is phosphor bronze, an alloy steel, "K" Monel, a stainless steel or beryllium copper, metallurgical control is exact from ingot to finished tube. Socket and tip joints are welded or brazed, then stress relieved for highest strength and safety. "Whip testing" at pulsating pressures at least 50% greater than rated pressure insures calibration stability.

Order your Ashcroft Duragauges with the best Bourdon tube material for your service. Choose the all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. Full range of pressures, dial sizes, case designs and materials available. In any combination of components, Duragauges give sustained high accuracy and long service. Get details from your industrial supply distributor.

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ASHCROFT PRESSURE GAUGES

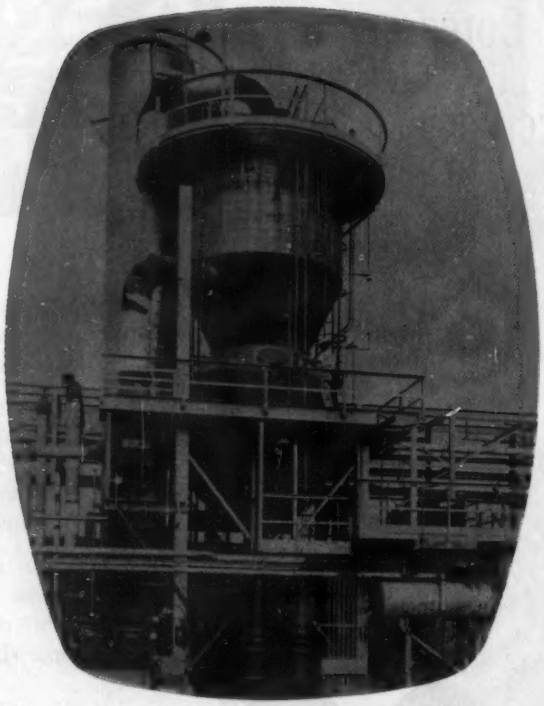
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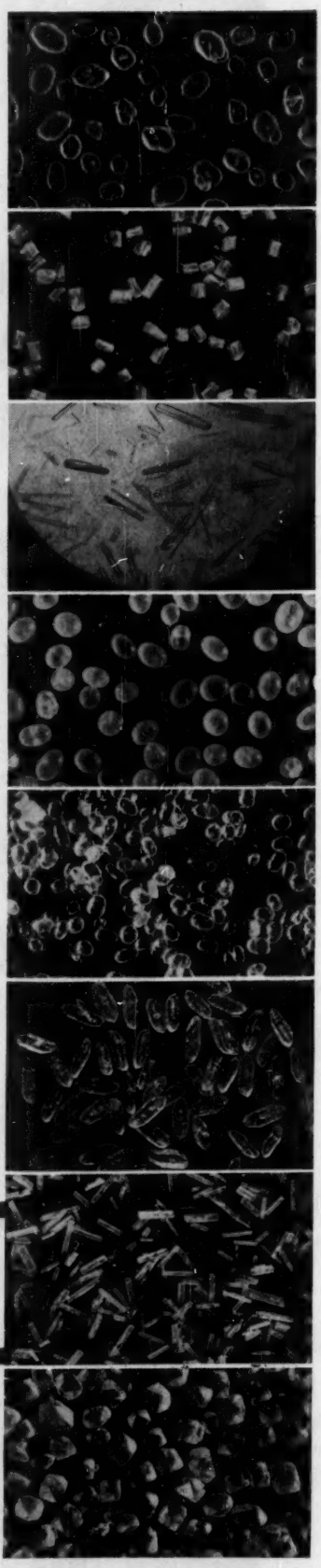
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STRUTHERS WELLS KRYSTAL Crystallizers assure you not only product superiorities but operating advantages that include: lower centrifuging costs; less processing; dust elimination; lower drying costs; a free-flowing product; minimum caking and many other time and money-savers. Write now for Bulletin CE-57.

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Why external recalibration is important to users of industrial thermometers

Sometimes it is necessary to recalibrate thermometers in industrial installations due to severe shock from rough handling, or to calibrate for extreme accuracy at any point on the scale for special work range.

To recalibrate the ordinary bimetal thermometer, you must remove the dial glass and move the pointer by hand. You will achieve the desired recalibration of course, but a number of undesirable things may also result. First of all, the instrument's air-tight seal is automatically destroyed in the removal of the dial glass. Secondly, in forcing the pointer, the pointer shaft may become bent or twisted.

Should the pointer shaft become bent even slightly, it can cause the pointer to stick due to improper alignment of the bimetallic shaft on its bearing surfaces. The obvious result, of course, will be inaccurate readings and necessary repair or replacement of the instrument. *None* of these things can happen with the RMC external recalibration device.

A simple dial-reset screw, located on the back side of RMC industrial thermometers, permits recalibration without opening the instrument in any way. This external recalibration feature is *exclusive* with RMC, along with true dry-air hermetic sealing.



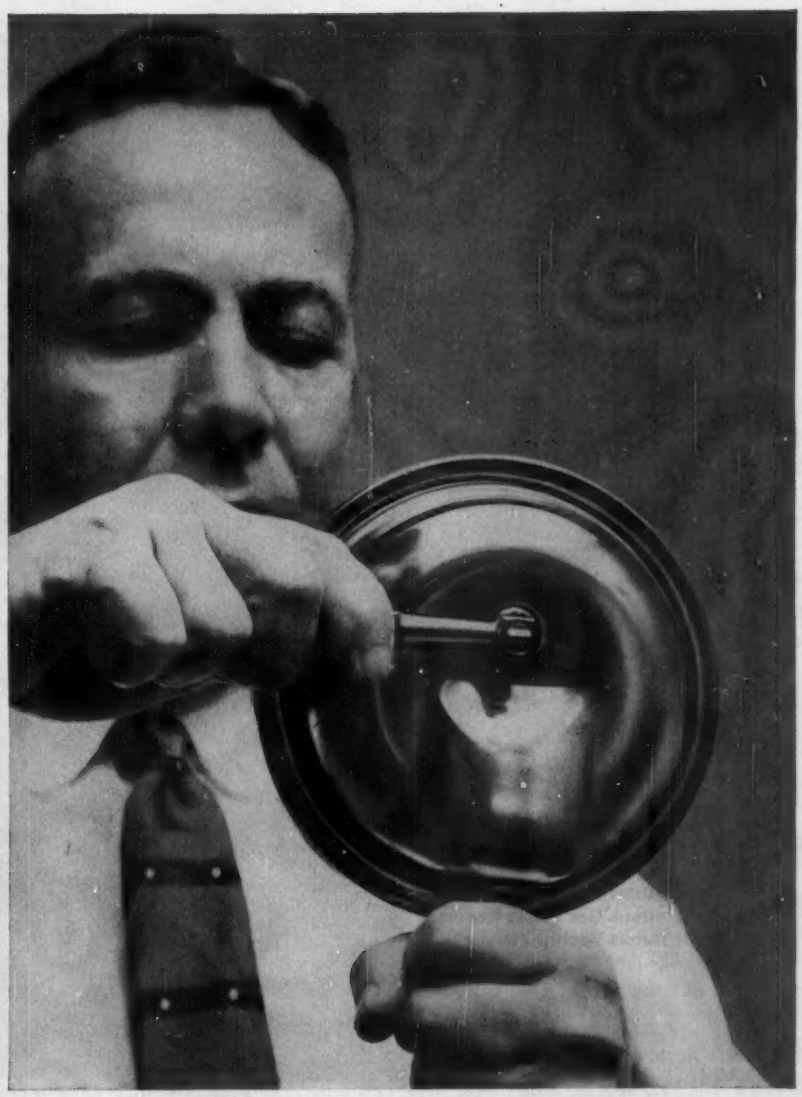
SHIPPINGPORT, Pa.—Heavy-duty dial thermometers play an important role in the operation of the world's first full-scale atomic-electric generating station devoted exclusively to civilian needs. These thermometers, manufactured by RMC, can be recalibrated externally. The plant is a joint project of Westinghouse Electric Corporation, Atomic Energy Commission and Duquesne Light Company of Pittsburgh.

RMC high pressure gauge, developed for missiles, now available to industry



RMC-LINDSAY PRESSURE GAUGES indicate pressures in ranges 0 to 1,000 psi., up to 0 to 15,000 psi., with retard scales available. Multiple coil, helical Bourdon tube type, with pointer attached direct—no linkages or pivots. Can withstand extreme shock, vibration, temperature, or overpressure and maintain consistent accuracy.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill go to work for you. ROCHESTER MFG. CO., 113 Rockwood St., Rochester 10, N. Y.



This maintenance engineer is recalibrating an RMC bimetal dial thermometer by means of the exclusive RMC *external* dial reset screw—a simple on-the-job operation with RMC thermometers.

RMC external recalibration device saves thermometer's hermetic seal

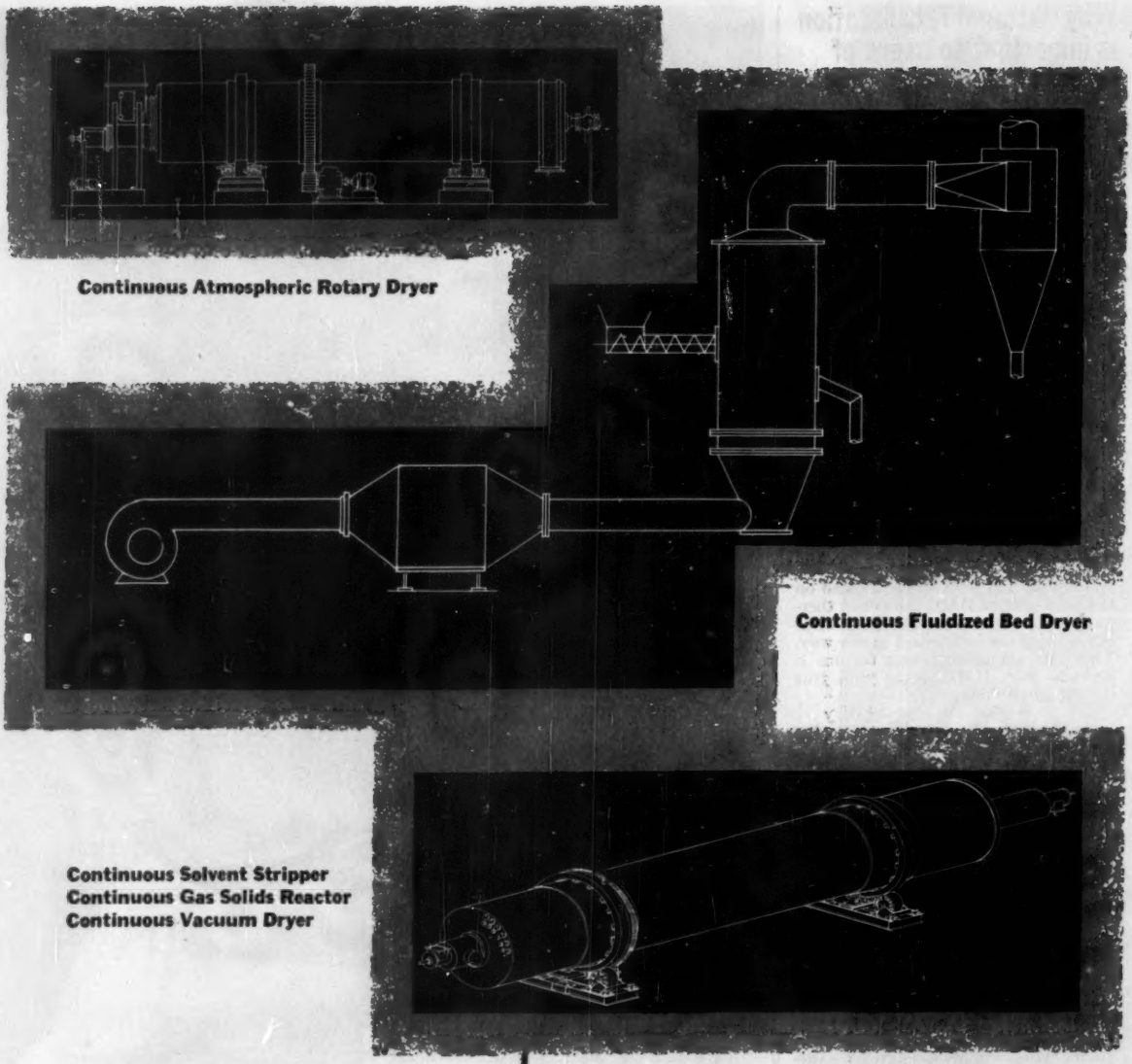
With this *external* dial reset screw you can recalibrate your RMC thermometer easily and safely, should it ever be necessary. The all-important hermetic seal cannot be destroyed and there is no chance for damage to the critical pointer shaft. You get the *only* bimetal industrial thermometer that provides for *external* recalibration when you specify RMC.

RMC

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113 ROCKWOOD STREET • ROCHESTER 10, N.Y.

LIQUID LEVEL TEMPERATURE and PRESSURE INSTRUMENTS

REPRESENTATIVES IN ALL PRINCIPAL CITIES



Continuous Atmospheric Rotary Dryer

Continuous Fluidized Bed Dryer

Continuous Solvent Stripper
Continuous Gas Solids Reactor
Continuous Vacuum Dryer

Now, at one convenient location, you can test-dry your materials in a variety of equipment

At General American's East Chicago pilot plant, you can test the drying or reacting of your materials in the widest range of drying equipment ever assembled in one place.

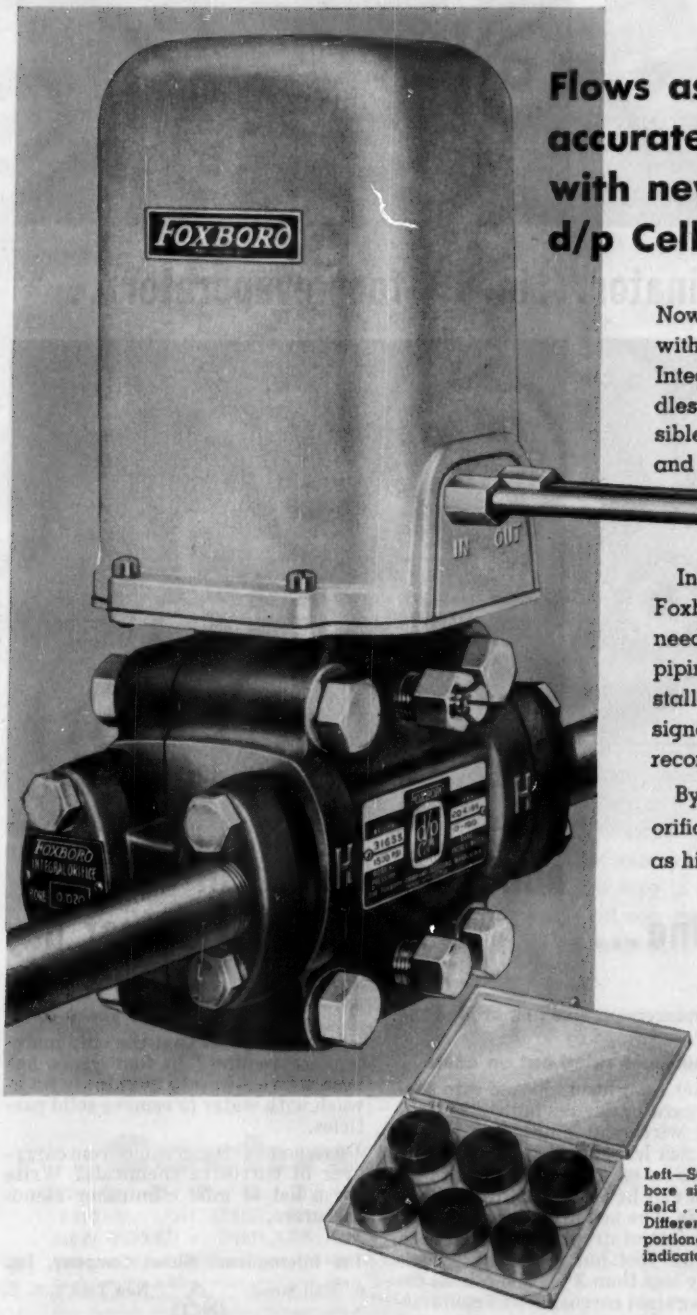
Louisville Dryer engineers will work with you—study your materials and needs, make recommendations for type of equipment, size and heating medium. You can check these recommendations for yourself through practical tests. Your Louisville Dryer is then engineered for most efficient and economical service—built specifically to meet your needs.

To test the drying of your materials in all these different types of drying equipment, call in a Louisville Dryer engineer. There is no cost or obligation.

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LOUISVILLE DRYER DIVISION
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FOXBORO BREAKS "RANGE BARRIER" IN SMALL-FLOW TRANSMISSION



Flows as small as .003 gpm accurately measured, with new Integral Orifice d/p Cell* Transmitter

Now you can measure and transmit small flows with full accuracy and dependability! The new Integral Orifice d/p Cell Transmitter easily handles exceedingly low flow rates formerly impossible in pilot plant operations, research problems, and fluid ratioing.

Installed directly in the process line, the Foxboro Integral Orifice d/p Cell Transmitter needs no meter primary device or connection-piping . . . and no straight runs. It can be installed in any position. A direct 3-15 psi output signal is delivered to any standard indicator or recorder.

By suitable range selection through change of orifice inserts, flow rates as low as 0.003 gpm or as high as 8.0 gpm can be accurately measured.

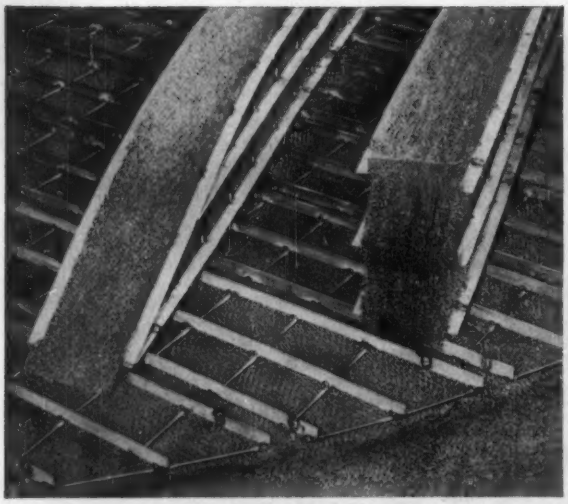
The Foxboro Type 13A Integral Orifice Transmitter gives you, not only new high accuracy in measurement, but also accurate remote indicating and recording. Write for complete details. **The Foxboro Company, 368 Neponset Ave., Foxboro, Mass., U.S.A.**

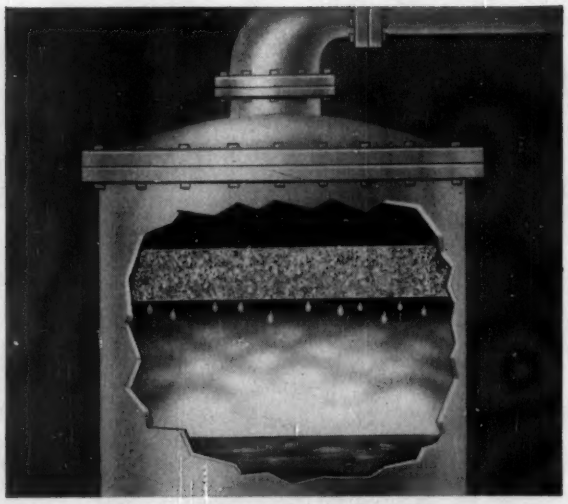
*Reg. U.S. Pat. Off.

Left—Set of six interchangeable orifices is available in standard bore sizes from 0.020" to 0.250". They're easily changed in the field . . . merely inserted within the transmitter connection block. Differential pressure across orifice is converted to directly proportional 3-15 psi air output signal and transmitted to remote indicator or recorder.

FOXBORO
REG. U.S. PAT. OFF.

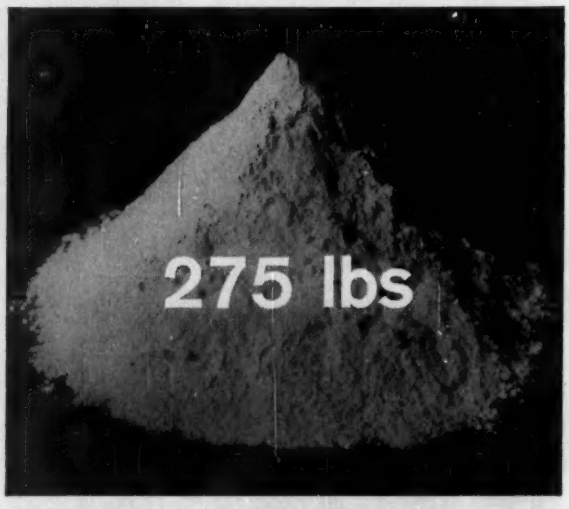
INTEGRAL ORIFICE d/p cell transmitter





Nickel wire mist eliminator... in 8½-foot evaporator...





Stops corrosion of 30-inch vapor line... and saves $8 worth of NaOH per day

Costly carryover of corrosive liquids entrained in vapor can be stopped easily and economically with Nickel Alloy wire mist eliminators.

That was proved again very recently by the experience of Frontier Chemical Company, a Division of Union Chemical and Materials Corp.

Frontier concentrates some 50 tons per day of 50% NaOH in an 8½-foot evaporator. Caustic carryover from the evaporator was causing an $8 per day loss in product and expense of neutralization. The 30-inch vapor line was corroding badly, too, and expensive replacement was just around the corner.

Separators ruled out on costs

Frontier's engineers looked into several separator devices but the knitted Nickel wire mist eliminator shown above cost less than half as much. It requires no major change in the vessel and can be installed through the manhole. The pad provides about 100 square feet of droplet collection area per cubic foot but reduces free volume by less than 3%. The Nickel insures against corrosion and contamination problems.

Four trouble-free years

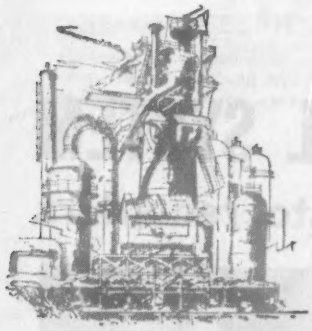
Frontier reports that the only maintenance required in four years has been a twice-weekly 30-minute backwash with water to remove solid particles.

Are you having trouble from carryover of corrosive chemicals? Write for a list of mist eliminator manufacturers.

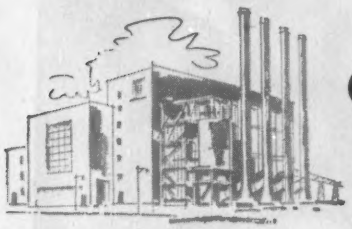
The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK

INCO NICKEL ALLOYS

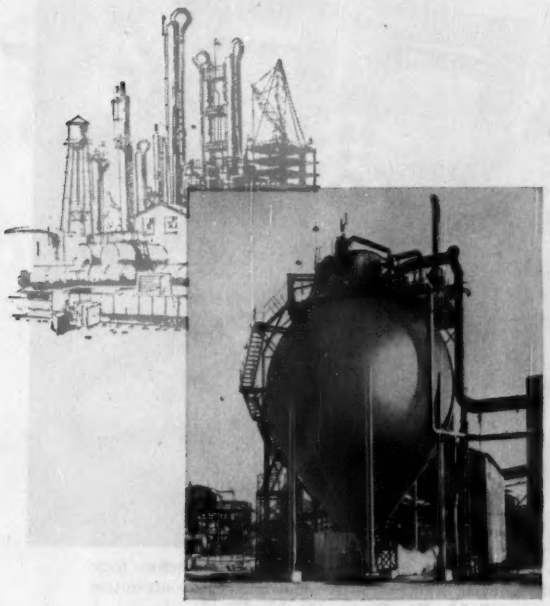


First in water conditioning



Cochrane HOT PROCESS

AT U.S. STEEL'S CLAIRTON PLANT



Designed to soften and deaerate 100,000 GPH of boiler feed water, this Cochrane unit at U.S. Steel's plant is a sludge blanket design deaerating type Hot Process Softener with a 38' dia. spherical top sedimentation tank. The Softener is followed by six 11' dia. anthracite filters equipped with surface washers.

Cochrane pioneered the versatile Hot Process Softener. Its flexibility and efficiency are unquestioned and it provides a water softening process that can handle both turbid surface supplies and clear well waters.

Cochrane Hot Process Softeners can be used to reduce silica economically and effectively. It is also possible to provide integral deaeration elements for condensate and treated makeup where required.

For medium and high pressure boilers, Hot Process can be followed by Hot Zeolite to provide zero hardness and lower solids as well as to reduce CO_2 in the steam.

If you now have a Hot Process Softener, Cochrane Hot Zeolite may be readily added, assuring higher effluent quality at lower treating cost.

Cochrane, first in water conditioning for over half a century, continues to lead the way in Hot Process and Hot Zeolite. Call our engineers for the answer to your problem. Ask for Publication 4801.

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Representatives in 30 principal cities in U.S.; Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii; Manila, Philippine Islands.
Pottstown Metal Prods. Div.—Custom built carbon steel and alloy products.

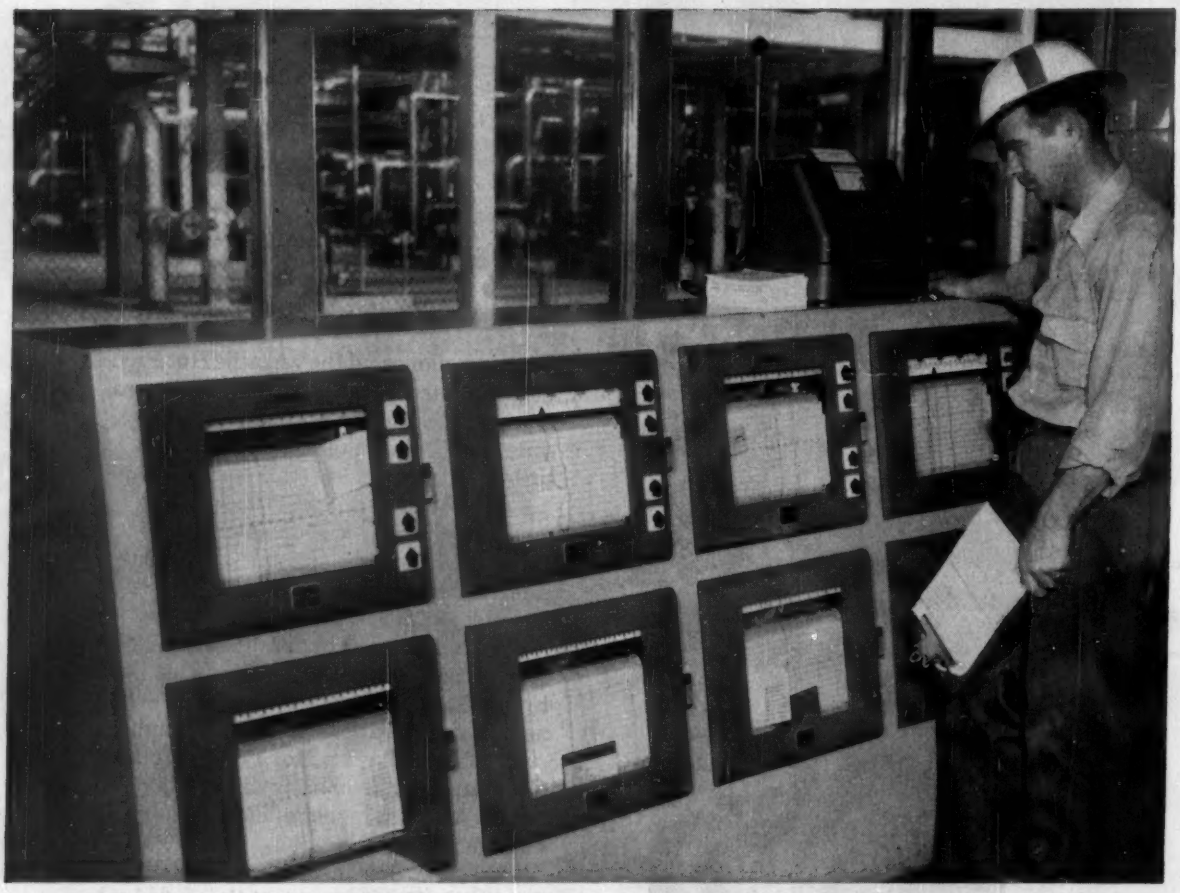
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Demineralizers • Zeolite Softeners • Hot Process Softeners • Hot Lime Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Pressure Filters
Continuous Blowoff Systems • Condensate Return Systems • Steam Specialties

Ad. 2.01

"MILLION-DOLLAR" CONTROL SYSTEM

spots trends with Bristol recorders



THESE MULTIPLE-CHANNEL BRISTOL TREND RECORDERS—one of several such groups—can spot troubles before they start at the Delaware Refinery of Tidewater Oil Company. All of the self-balancing bridge and potentiometer instruments in this modern plant are Bristol's. Instrument system designed and installed by Panellit Inc., Skokie, Illinois.

Designed to nip trouble in the bud, the "million-dollar" control system at the Delaware Refinery of Tidewater Oil Company features the latest analogue-to-digital scanning and logging techniques—and several batteries of patchboard-connected Bristol Dynamaster* trend recorders that can display almost any variable measured or controlled in the entire plant.

This uniquely flexible system lets the operator, in any of the plant's nine control rooms, record only those variables that need close, continuous checking. He simply plugs the recorders into the desired circuits at the patchboard and gets continuous records as needed.

Bristol Dynamaster electronic instruments are ideal as general-purpose recorders like these, and for special applications, too. The Dynamaster's high accuracy, outstanding flexibility, extremely broad range of accessory equipment, easy adaptability and exclusive features like No-Batt Continuous Standardization make it a consistent favorite among instrument men everywhere.

Find out how Bristol instruments—the most complete line of full-sized and miniature electronic and pneumatic instruments on the market—can help solve your difficult problems in recording, indication or automatic control. Write: The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

T. M. Reg. U. S. Pat. Off. 8.8

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

ONE OF A SERIES

Printed by offset lithography on 70-lb. paper containing Wyandotte PURECAL® in the coating.



What is the real measure of success for technical service?

You certainly can't measure the value of technical service in terms of the number of "good will" tours made through a customer's plant.

Or the amount of money spent each year for technical service.

Nor by the number of "service" requests received. Or by how hard or long one tries to solve a technical or processing problem!

The only way to evaluate technical service is in terms of results!

Wyandotte customers like our technical service . . . they know that it is deep-rooted and sincere. Here are some results:

An ink manufacturer writes: "Wyandotte technical service showed us how to reslurry dry PURECAL* in our own plant and get the results we were after . . . this lowered our freight charges, prevented freezing, eliminated both the cost and handling of metal drums. They were a great help to us."

A water-conditioning manufacturer states: "A Wyandotte service representative pointed out the product benefits of PLURONIC* surfactants in boiler water-treating compounds and in cooling-water systems . . . saved us research time by prompt action and supplying the proper technical data on their products."

A textile-processing mill says: "Wyandotte technical service helped us effect a savings of 18% annually in caustic-soda costs—and removed certain handling hazards at the same time."

You can get the benefits of Wyandotte's technical service, too. Just send us as much information as possible on your product or processing problems, and the results you seek.

For a pictorial presentation of Wyandotte at work, turn the page. *Reg. U.S. Pat. Off.

WYANDOTTE CHEMICALS

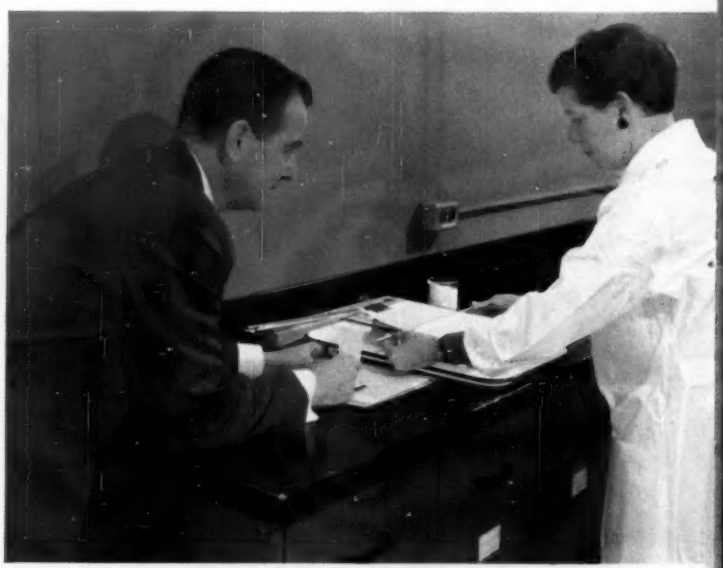
SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE • CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE GLYCOLS • SYNTHETIC DETERGENTS (anionic and nonionic) • CARBOSE® (Sodium CMC) • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • PROPYLENE OXIDE • PROPYLENE DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS • OTHER ORGANIC AND INORGANIC CHEMICALS

Smoothing out problems in papermaking

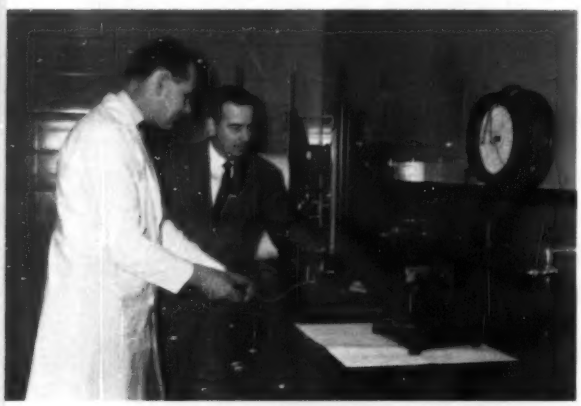
. . . an example of Wyandotte technical service at work



1 A paper company wanted to upgrade its coated stocks by giving them higher brightness, improved printability. The company's technical staff talks to Wyandotte technical-service man, who suggests formulation study using PURECAL.



2 Technical-service representative has technician in Wyandotte paper-application laboratory make a control of present coating for comparison with formulation changes.



3 Coatings using PURECAL in various combinations with clay are studied in smoothness-testing machine . . . followed by tests for brightness, gloss, adhesive demand, printability. (Care is taken not to change color make down.)



4 Laboratory report is presented to company's research director by technical-service man who discusses findings and expected finishing properties of new formulation.



5 Company's research director compares previous stock with new grade. The uniformity, high brightness, well-defined particle size of PURECAL result in better brightness and finish, improved printability, ease of make down. Next step: plant trial runs.

533

PURECAL®—Wyandotte's precipitated calcium carbonate—is solving problems for many industries . . . giving smoother finishes for paper, improving paints, giving better white-sidewall tire stocks. Point is: Wyandotte technical service, as demonstrated on this page, is available to all Wyandotte customers. If you have a problem that falls within our technological or manufacturing background, check with us . . . our approach is designed to provide answers. *Wyandotte Chemicals Corporation, Michigan Alkali Division, Wyandotte, Michigan. Offices in principal cities.*

Wyandotte CHEMICALS

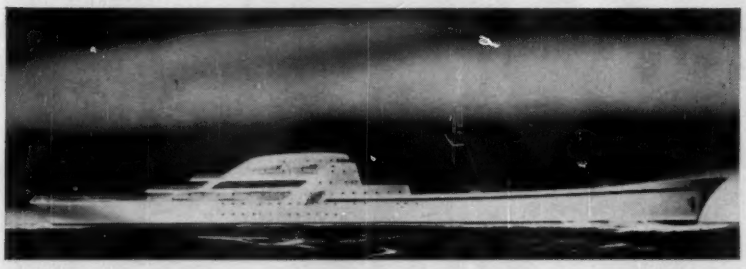
Pacing progress with creative chemistry

FRESH WATER NEWS

from Cleaver Brooks®

CAPSULE REPORTS AND INFORMATION ON THE PRODUCTION OF FRESH WATER FROM THE SEA

Cleaver-Brooks Flash Evaporators to furnish fresh water for first nuclear merchant vessel



When the world's first nuclear-powered passenger-cargo ship, the Savannah, goes to sea, her fresh water will be supplied by Cleaver-Brooks Flash Evaporators.

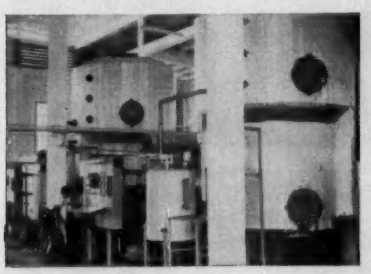
Long operational runs without attention for feed water treatment or interruption for cold shocking plus minimum installed cost are the reasons behind the selection of Flash Evaporators. With the keel already laid, preparation for installing these Cleaver-Brooks evaporators moves ahead.

Widely recognized for having simplified the age-old scaling problem, the Cleaver-Brooks flash evaporators require less auxiliary equipment and less attention than any other type.

Cleaver-Brooks makes a complete line of flash evaporators for shipboard, seaboard and offshore rig use.

And for the Navy . . . Cleaver-Brooks will provide a 280,000-gallon-per-day fresh water plant for its first nuclear-powered aircraft carrier, now under construction at the Newport News Shipbuilding and Drydock Company.

It will be the largest distilling plant of any type ever installed on a sea-going vessel and the largest sea water plant in operation in the United States.



ECUADOR WATER PLANT EXPANSION

Continually plagued by lack of rain and high cost of importing fresh water, the coastal town of Salinas — several years ago — solved its problem of water shortage by installing 100,000 GPD capacity vapor compression sea water distillers. The tremendous local acceptance of distilled water as the potable municipal supply meant an increasing population and greater demand for water.

Now the outstanding vacation spot for Ecuadorians, Salinas is doubling the size of the water plant with the addition of the simple, low cost Cleaver-Brooks flash evaporators. The use of surplus natural gas (available from nearby oil wells) as primary fuel is expected to bring the cost of fresh water well below any previous experience in this area.

Many other coastal municipalities are now studying the situation to determine how their fresh water shortages can be similarly solved to aid population growth and municipal expansion.

GIBRALTAR TO GET ADDITIONAL CLEAVER-BROOKS EVAPORATORS

Under contract with the British Admiralty, Cleaver-Brooks is installing a new 145,000 GPD flash evaporator plant with boilers which will be placed into operation early 1959. While the new Flash plant is for the NATO Base, Cleaver-Brooks is not a newcomer to the "Rock" as the City of Gibralter has been operating a vapor compression distilling plant since 1952.

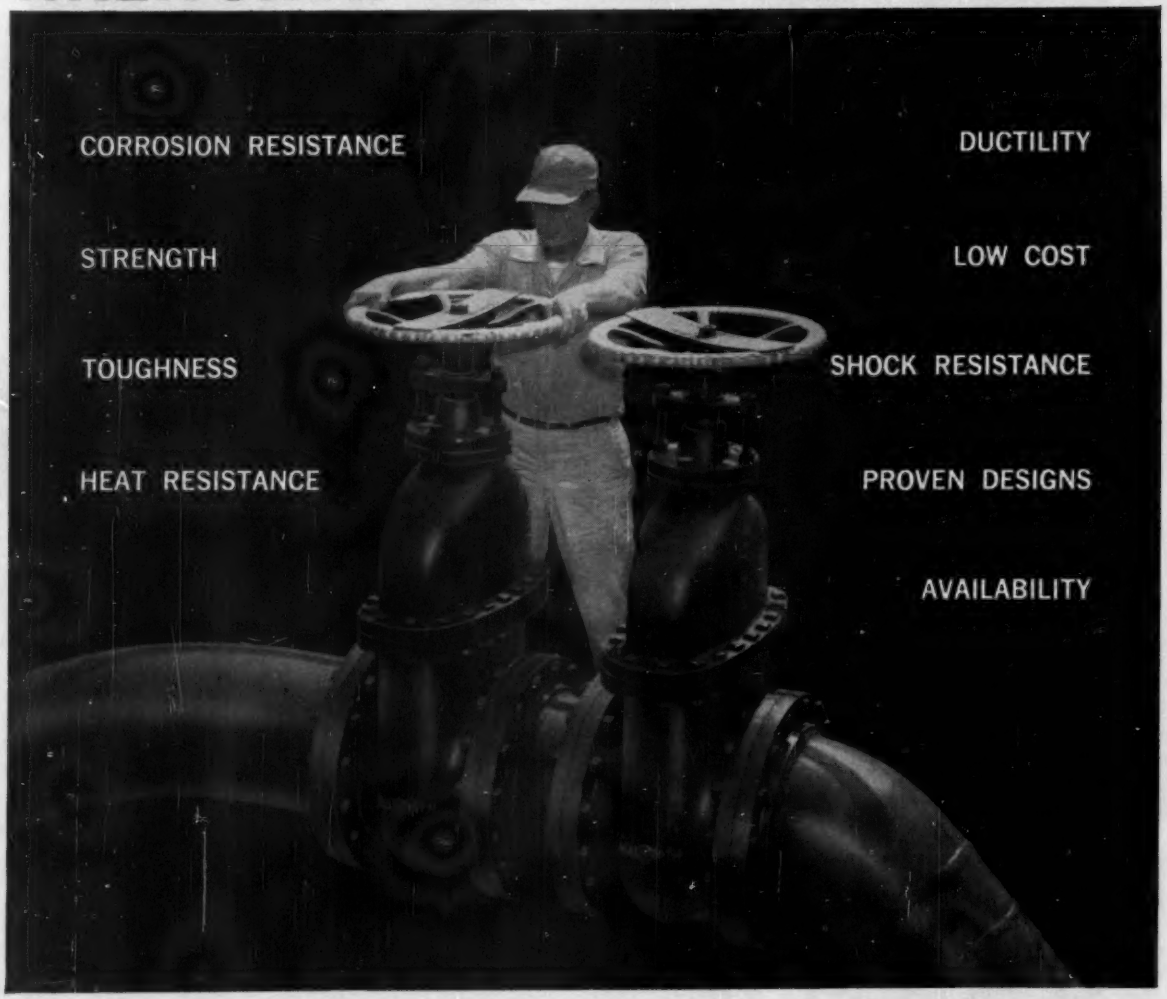
Of particular interest in this plant are the design restrictions imposed by transportation and road facilities to the final site. With much of the fabrication arranged in England through subcontractors, final assembly must be completed at the ultimate location to stay within transportation weight limitations.

For helpful suggestions that solve your fresh water problems send details to: Dept. CE-88, Cleaver-Brooks Company, Special Products Division, 225 Grand Avenue, Waukesha, Wisconsin.

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BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT

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WALWORTH DUCTILE IRON VALVES



Walworth ductile iron valves give you – at low cost – corrosion resistance comparable to gray cast iron . . . strength approaching that of carbon steel . . . long life expectancy and minimum maintenance. Proven shock resistance . . . Walworth ductile iron valves have functioned satisfactorily after being heated to 1350°F and suddenly quenched.

When you buy Walworth ductile iron valves you get the benefit of Walworth's proven engineering and designs. Sizes ⅛ to 24 inches, screwed or flanged ends, OS&Y and NRS types.

For your copy of the new circular on ductile iron valves, contact your local Walworth distributor, or, write Walworth direct.

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750 THIRD AVENUE, NEW YORK 17, N. Y.

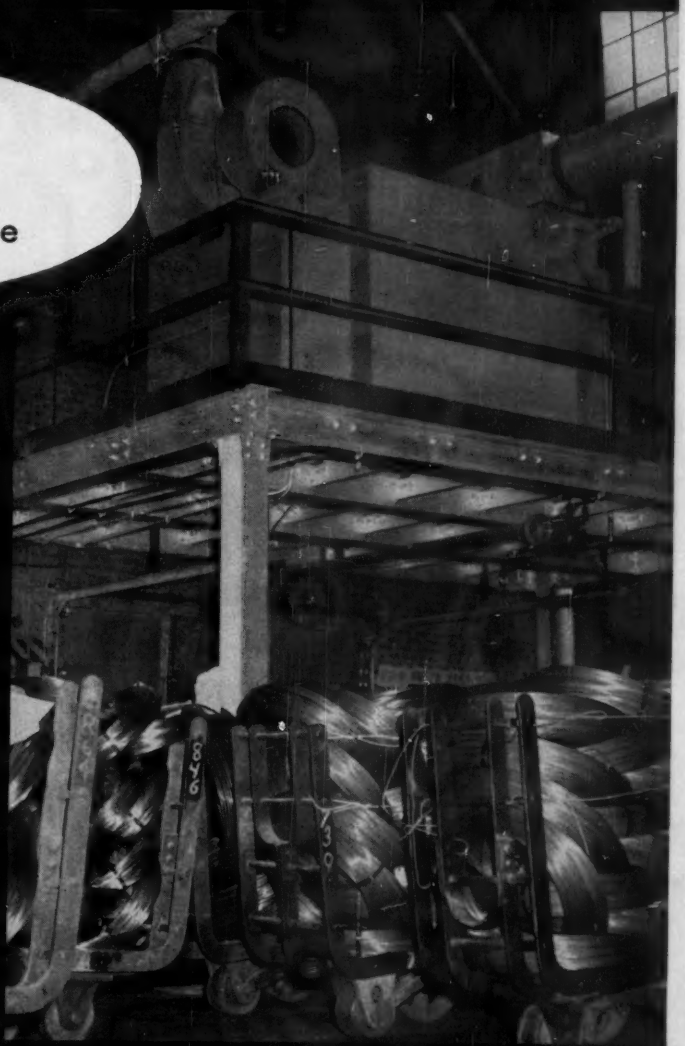
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keeps steel wire bright in 200,000 cubic foot warehouse



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This is the type of dehumidifying operation in which only a *properly* engineered and built DRYer can assure consistent, trouble-free performance . . . or the most profitable DRYing results. Lectrodryer recommendations are based on broad experience . . . more than 25 years of helping manufacturers keep product quality up, production costs down.

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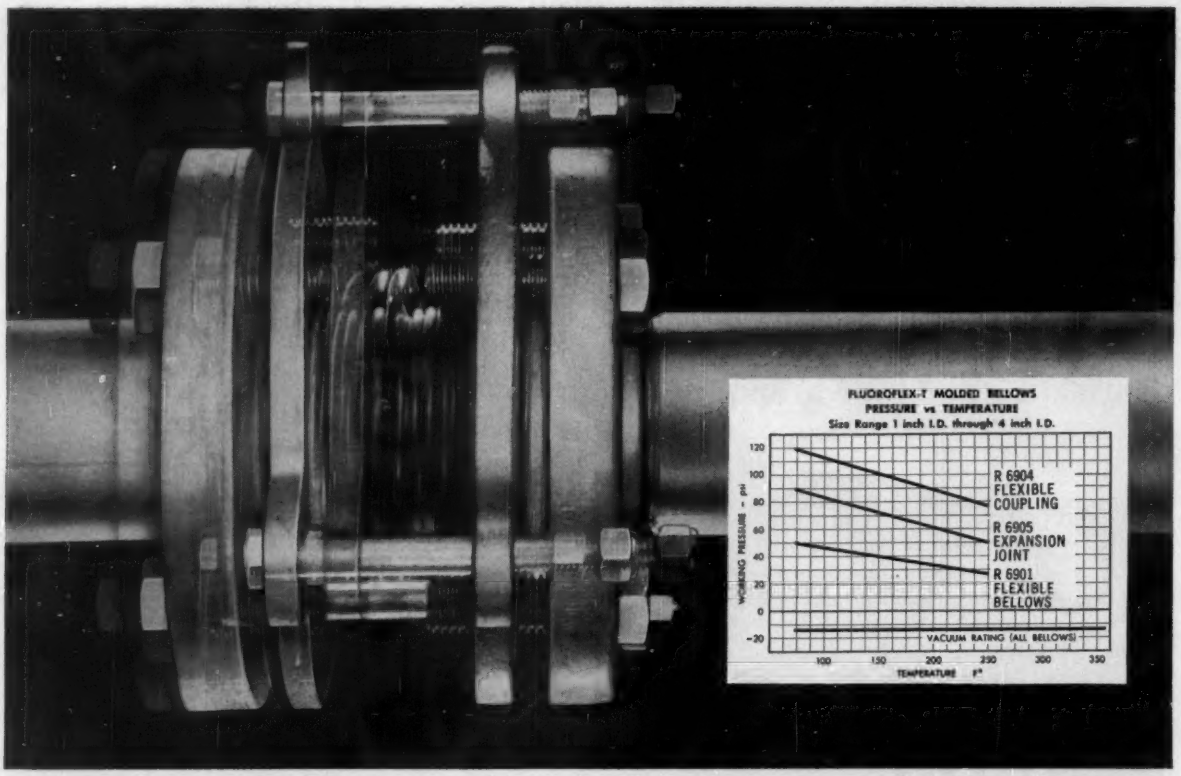
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Fluoroflex®-T expansion joints molded from Teflon®

stand higher dynamic pressure

- **Work over wide pressure range** — and under full vacuum, too
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- **Molded — not machined** — for undamaged grain structure and interior convolutions that don't fatigue and crack
- **Corrosion-proof** — universally useful with all fluids and all types of piping

® Fluoroflex is a Resistoflex trademark, reg., U.S. pat. off.
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Fluoroflex-T bellows and flex joints are made of a special high density compound . . . Teflon at its best. Molding assures the optimum tensile and fatigue strength.

RESULT: *Twice the burst strength,* after flexing . . . 20 to 30 times the flex life of ordinary bellows machined from Teflon!

Chemically as well as physically durable, Fluoroflex-T bellows are inert to virtually all known chemical and corrosive solutions.

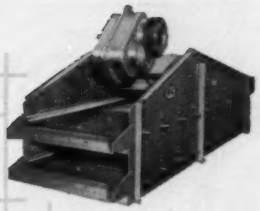
Investigate their full advantages – write for Bulletin B-1. RESISTOFLEX CORPORATION, Roseland, New Jersey. Southwestern Plant: Dallas, Texas. Western Plant: Burbank, Calif.

RESISTOFLEX

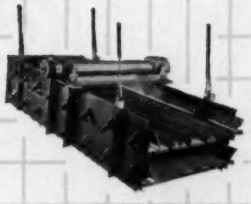
Complete systems for corrosive service



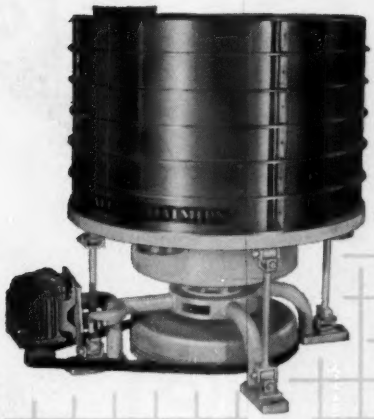
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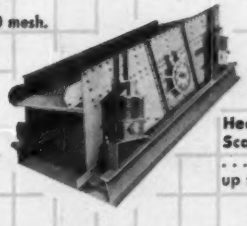
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. . . for separations up to 2½ inches.



Small Inclined Screens
. . . for separations 1½ inches to 40 mesh.



Stainless Steel Gyratory Screen
. . . for size classifications 2 to 325 mesh.



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. . . screen apertures up to 12 inches.

SCREENS

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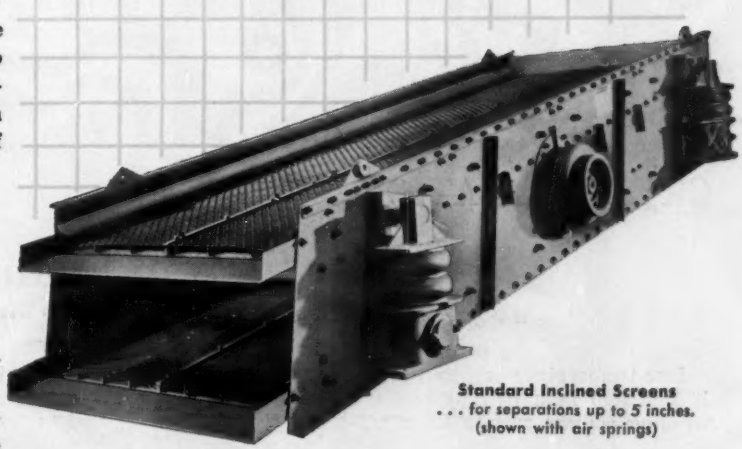
. . . From smallest to largest

. . . Separations from 12 inches to 325 mesh.

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. . . for separations up to 5 inches.
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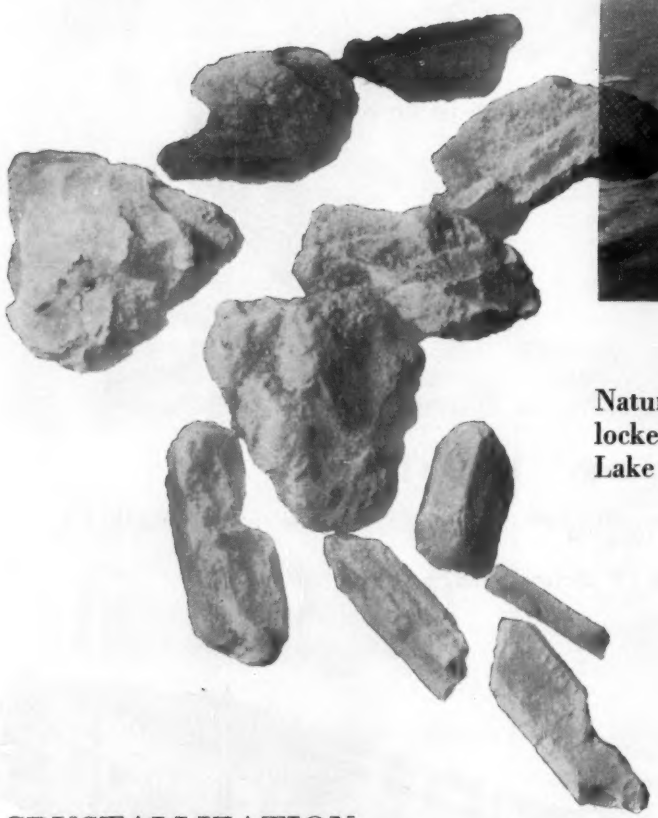
A-5583

PRACTICE . . .

PROCESS FLOWSHEET

C. H. CHILTON





Natural sodium sulfate is unlocked from complex Searles Lake brine.

CRYSTALLIZATION:

Key Step in Sodium Sulfate Process

Low-temperature crystallization is key step in a new process for winning sodium sulfate from natural brine.

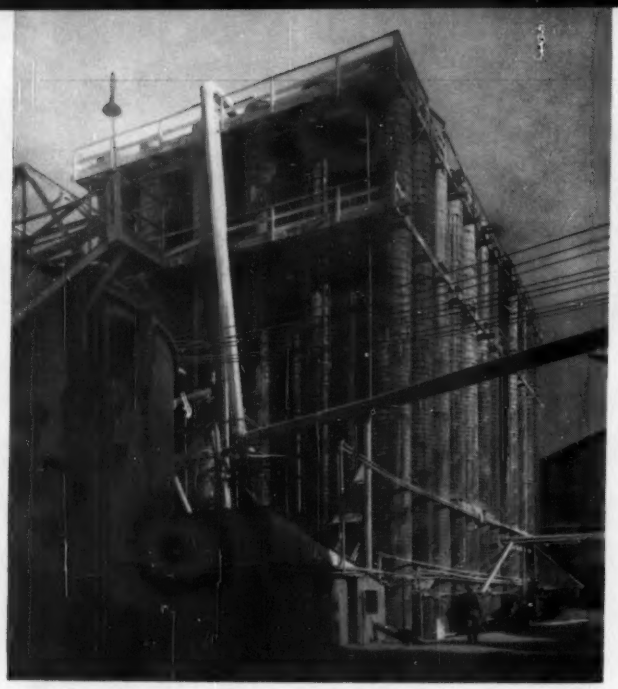
Developer and user of the process is West End Chemical Co. (a division of Stauffer Chemical Co.), located at Westend, Calif., on the shores of Searles Lake. The company daily turns out 400 tons of anhydrous sodium sulfate (salt cake), a sizable slice of the country's 1-million-ton per yr. market.

▶ **Borax Gives Trouble**—Real problem that faces West End in isolating sodium sulfate from complex Searles Lake brine is due to the sulfate's similar solubility properties to those of borax, another constituent of the brine. Here's how this difficulty is overcome:

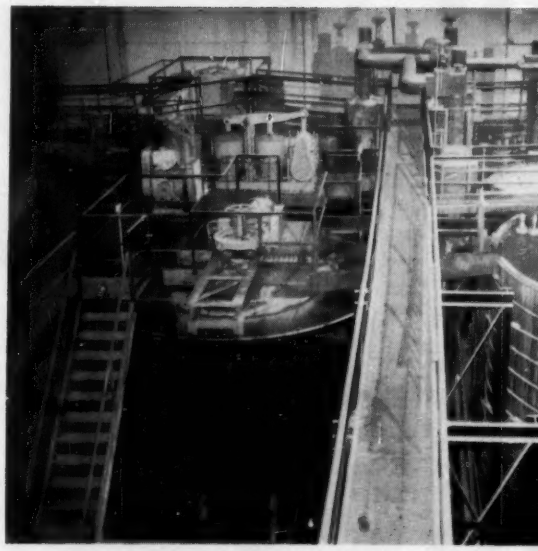
Brine is first freed of carbonate, then chilled to crystallize most of the borax. With the bulk of contaminants removed, brine is further chilled to crystallize sodium sulfate decahydrate (glauber salt), together with remaining borax. Crystals of borax are kept small so that they may be easily hydroseparated from the coarser sulfate crystals. Carefully controlled temperature and agitation are required.

American Potash & Chemical, only other producer of Searles Lake sodium sulfate (as glauber salt),

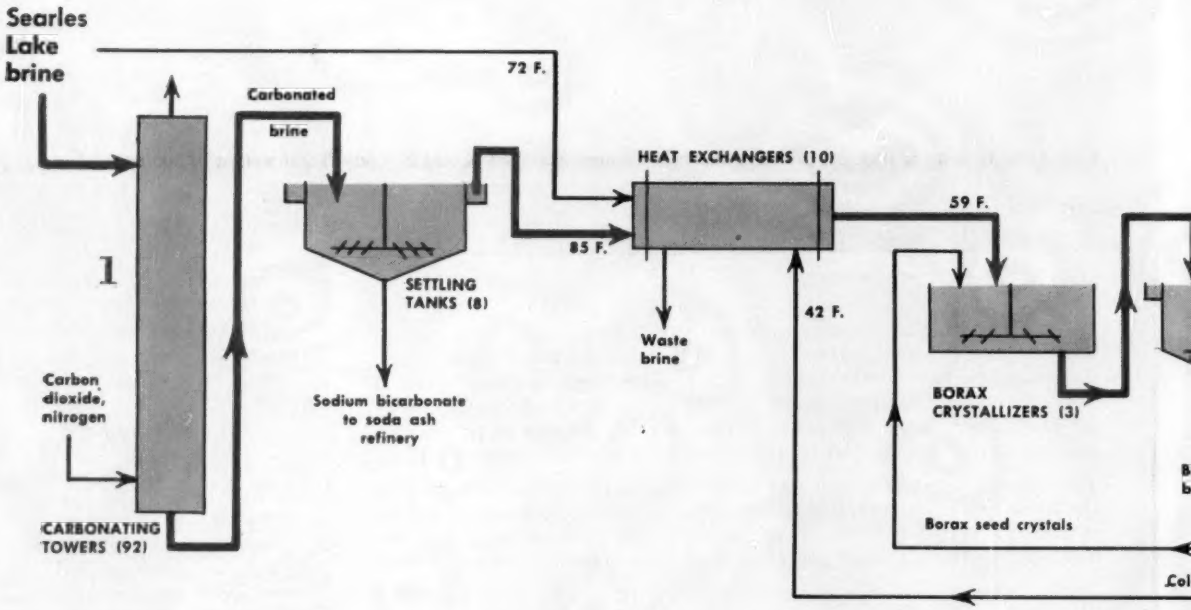
Unfold Flowsheet



1 CARBONATING TOWERS: In these 75-ft.-high, wooden towers, CO_2 converts carbonates to insoluble bicarbonates.



2 CRYSTALLIZING TANKS, 22 ft. high are equipped ing tubes. Here's where the glauber salt and bora



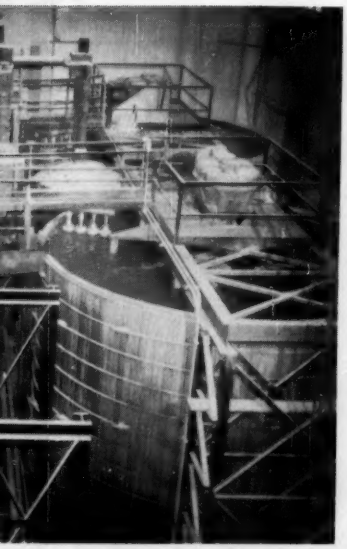
uses evaporation of brine to crystallize the salt. West End claims that cold crystallization gives greater economy and higher yields.

▶ **Carbonation Is First**—Brine is pumped from 65 to 115 ft. wells in Searles Lake through 14-in. mild-steel pipes to West End's sodium sulfate plant. Brine is first carbonated with CO_2 to convert dissolved carbonates to insoluble sodium bicarbonate. This is done in two sets of carbonating towers arranged in parallel. One set has 72 towers, each 5 ft. dia. and 75 ft. high; the other set has 20 towers, each 10 ft. dia. and 80 ft. high. Both sets are constructed of wood and are equipped with iron interior baffles.

Carbonation is accomplished by countercurrent contacting with gas containing 23% carbon dioxide. There are two sources of CO_2: West End's adjoining soda ash plant, and a limestone-burning rotary kiln (hydrated lime is another salable product).

Liquor from carbonating towers, bearing precipitated bicarbonate, goes to eight 20-ft.-dia. settling tanks. Bicarbonate settles and is raked out; it is main feed for West End's soda ash manufacture.

▶ **Cold Crystallization**— Overflow brine from settling tanks, now free of carbonate, is pumped through 10 stainless steel, shell-and-tube heat exchangers which cool it from 85 F. to 59 F. with cold (42 F.) exhausted brine. Here one part raw brine is added to nine parts carbonated brine to decrease acidity



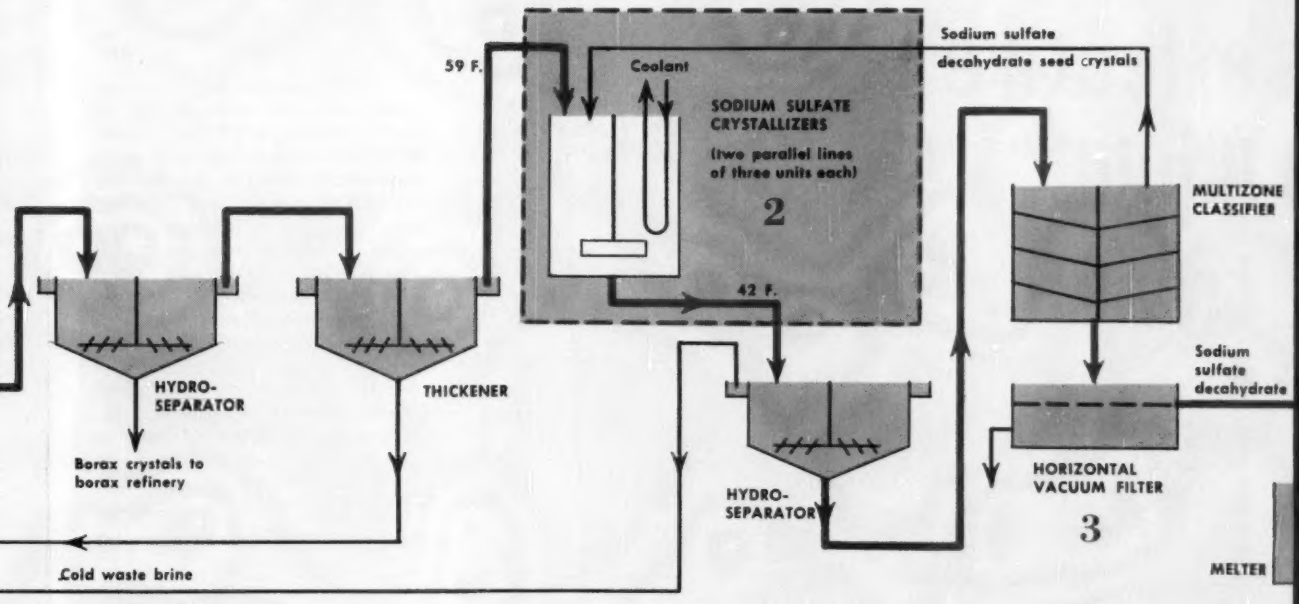
e equipped with agitators and cool- and borax crystallize out of brine.



3 HORIZONTAL VACUUM FILTER water-washes and air-dries glauber salt crystals from classifier.



4 DOUBLE-EFFECT EVA cake out of liquor fro



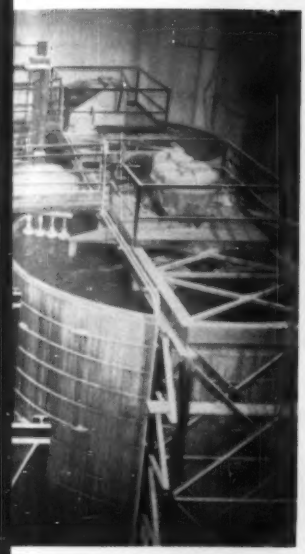
and convert sodium borate to sodium tetraborate (borax).

Chilled brine, now saturated with respect to borax, feeds three 50-ft.-dia. wooden crystallizing tanks. Fine borax seed crystals (recycled from an ensuing step) are added to saturated solution in order to induce crystallization of borax, while an agitator maintains proper conditions for crystal growth.

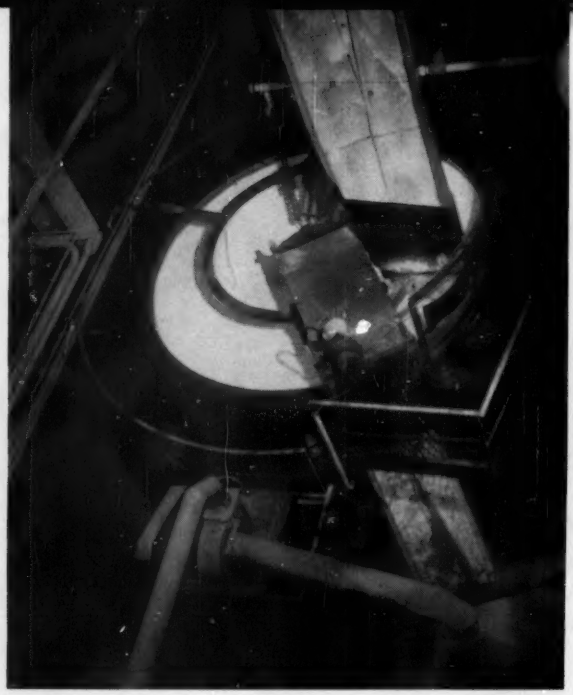
A hydroseparator classifies borax crystals taken from these tanks. Coarse crystal underflow goes to an adjoining borax refinery. Overhead, containing fine borax crystals suspended in brine, is sent to a 100-ft.-dia. thickener, where fines are separated and recycled to borax crystallizing tanks.

▶ **Crystallizing Glauber Salt**— Overhead liquor from thickener, free of carbonate and nearly free of borax, is pumped to a battery of six crystallizing tanks, arranged in two parallel lines of three tanks each. These open, wooden tanks are 22 ft. dia. and 22 ft. high, equipped with agitators and stainless steel cooling tubes (straight, not coiled). Crystallization of glauber salt results from cooling liquor from 59 F. to 42 F. and seeding with glauber salt fines.

Remaining borax in liquor crystallizes out with the glauber salt. However, controlled conditions keep borax crystals fine and glauber salt crystals coarse. Slurry from crystallizing units is pumped to a hydroseparator, where coarse crystals settle and fine crystals remain



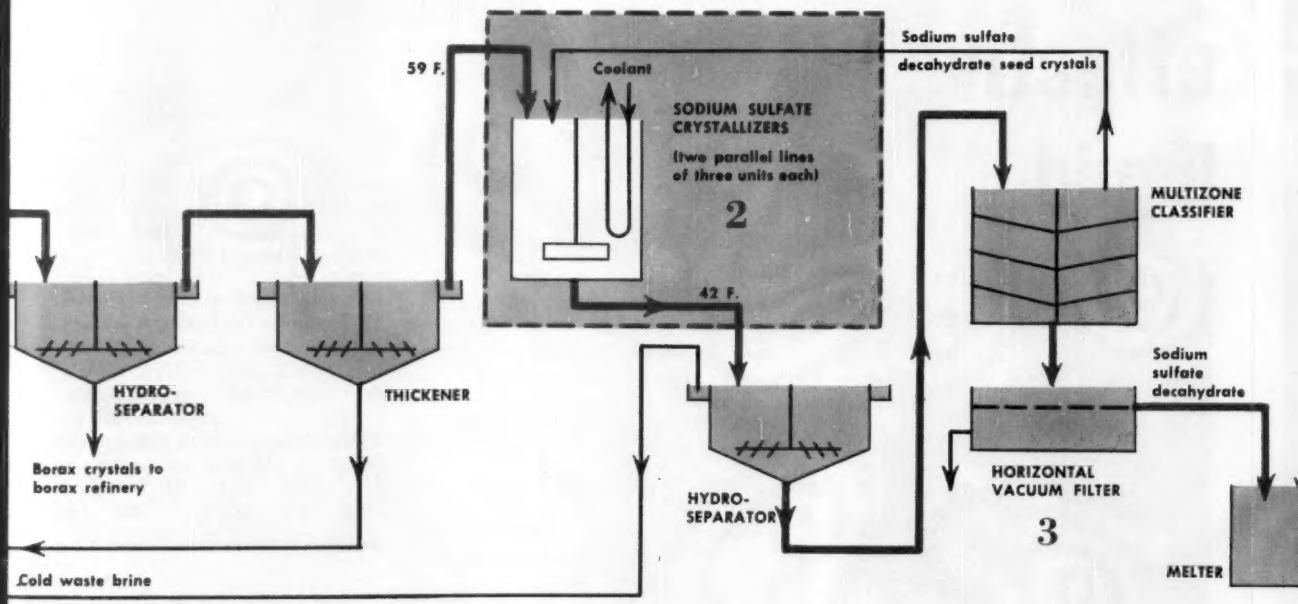
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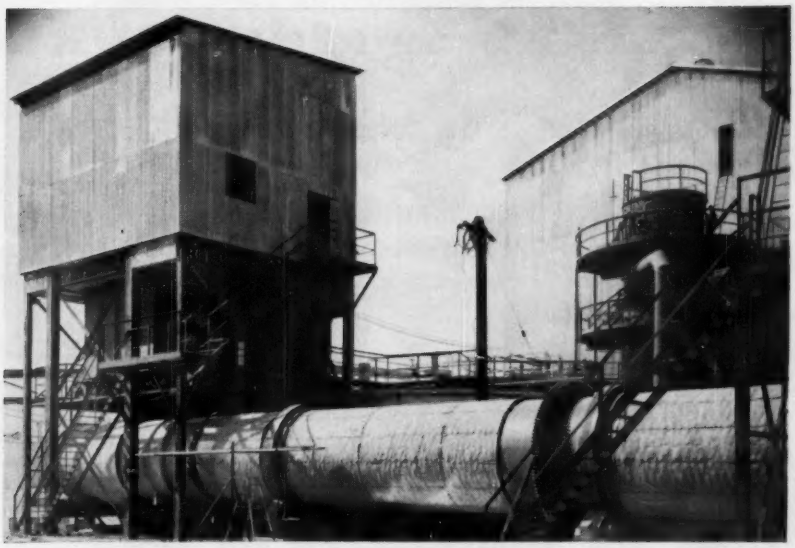
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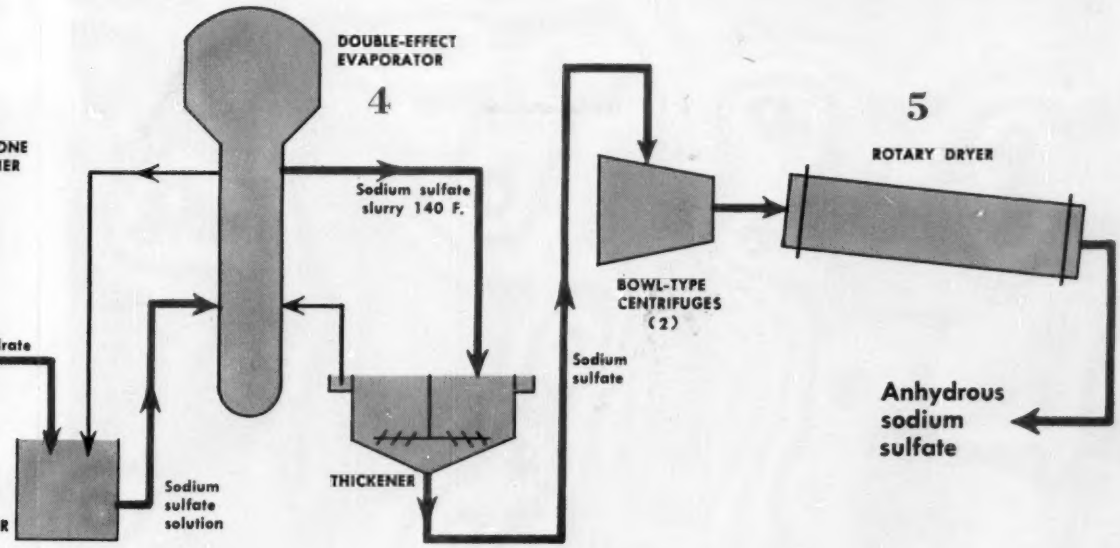
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Course



EVAPORATOR crystallizes salt from the glauber-salt melter.



5 ROTARY DRYER, direct-fired and operating at 275 F., dries wet salt cake from centrifuge to turn out 400 tons/day of marketable anhydrous salt cake product.



suspended in the exhausted brine.

Before spent brine is discharged as waste, its low temperature (42 F.) is utilized in cooling feed to borax crystallizers.

▶**Classifying the Crystals**—An 8-in. diaphragm pump transfers glauber salt crystals to an 8-ft. multizone classifier. This unit separates fine from coarse crystals. Fines are recycled to glauber salt crystallizer for seeding and further growth.

Course glauber salt crystals (larger than 20 mesh) are sent to a 13-ft.-dia. horizontal vacuum filter for water-washing and air-drying; large crystal size enhances thorough washing and increases rate of drying.

Washed and dried crystals drop directly into a melter, where hot (150 F.) sodium sulfate solution is added. Here, glauber salt melts in its own water of crystallization.

▶**Crystallizing Salt Cake**—Resulting concentrated solution of sodium sulfate goes to a stainless steel, double-effect evaporator; further concentration results in crystallization of anhydrous sodium sulfate; crystals leave the evaporator at 140 F.

A 30-ft.-dia. stainless steel thickener settles out sodium sulfate crystals and returns liquor to evaporator. Two solid-bowl centrifuges remove excess water from crystals. Crystals are finally dried in a rotary dryer operating at 275 F. to produce anhydrous sodium sulfate product.

For Custom Plate Fabricated

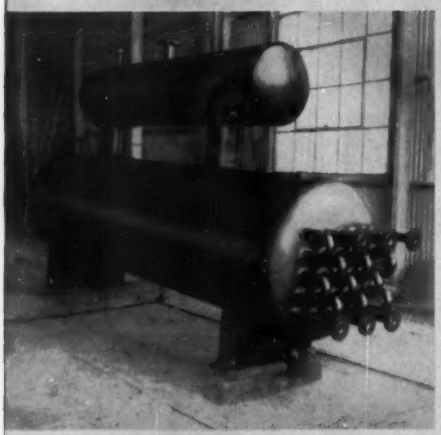
CODE TANKS and PRESSURE VESSELS

there is no substitute for *Experience*

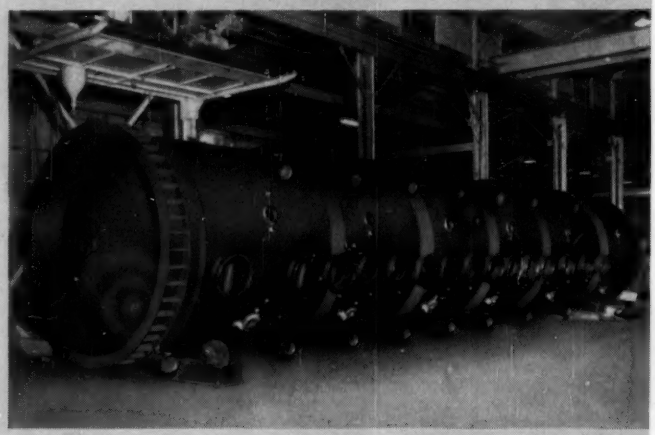
Modern Welding Company offers a wealth of experience in plate fabrication. Five well equipped Modern Welding Plants are strategically located to serve the Chemical Processing and Petroleum Industries. All plants are equipped to handle vessels that require exacting specifications.



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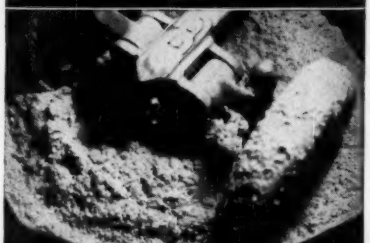
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Chemical Engineering

Practice

AUG. 11, 1958

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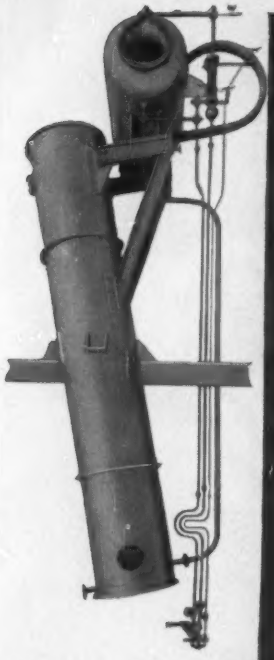
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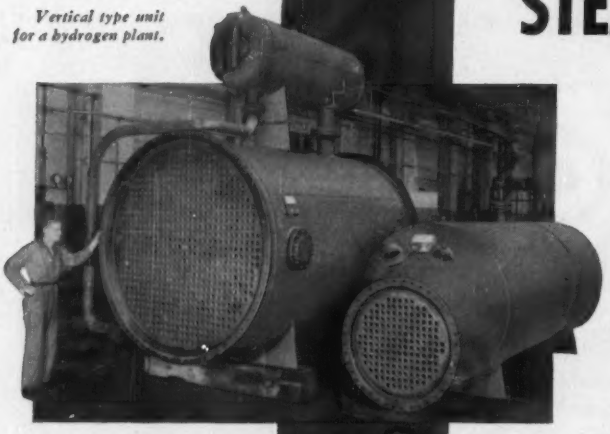
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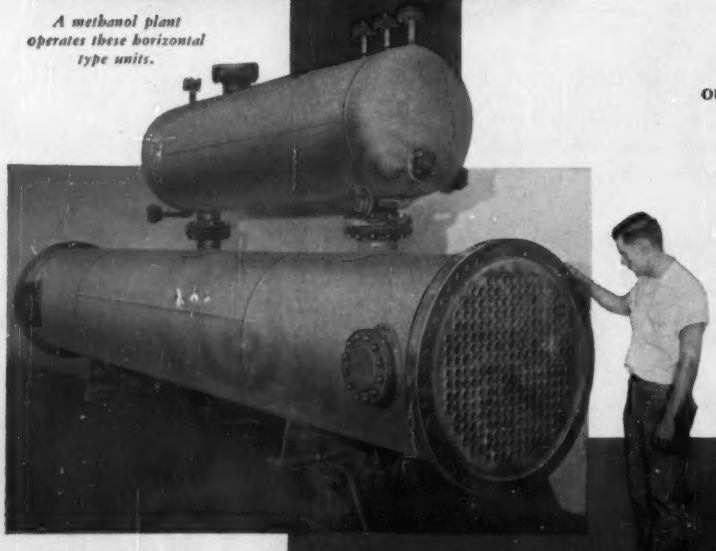
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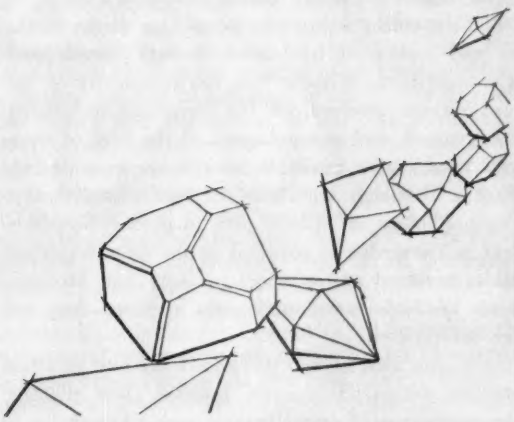
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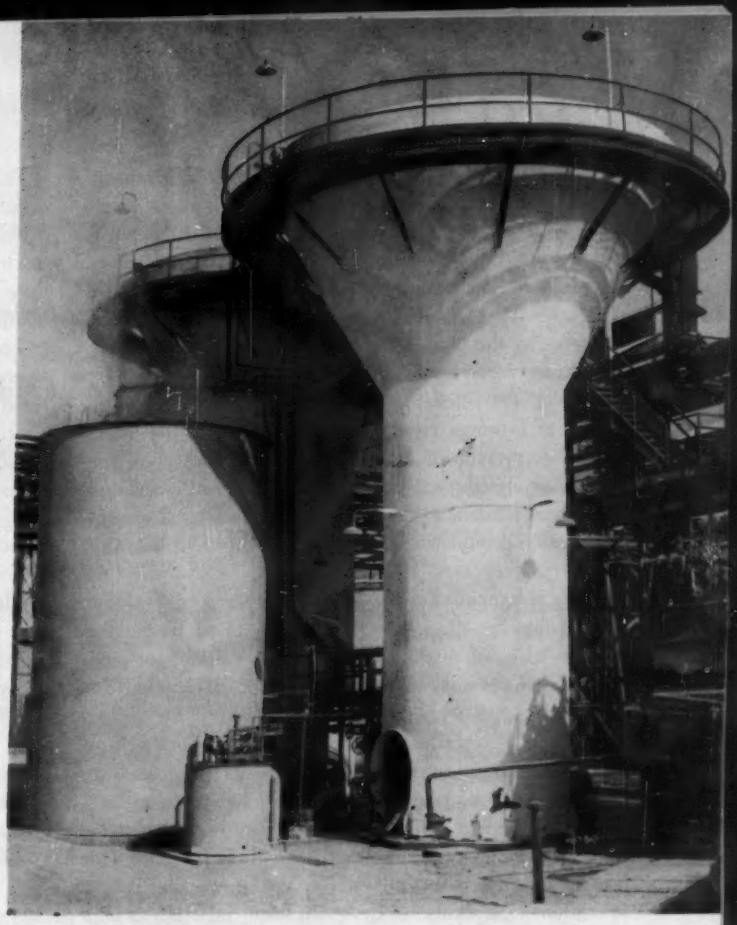
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FEATURE REPORT

Chemical Engineering

AUGUST 11, 1958





For Your Next Purification Problem . . .

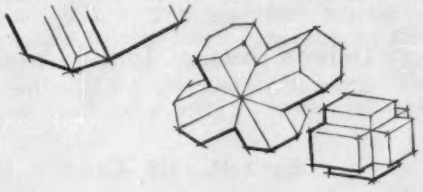
CRYSTALLIZATION

Aimed primarily at design and development engineers, this timely information on theory, equipment and costs is must-reading for operating men, too.

DONALD E. GARRETT & GERHARD P. ROSENBAUM
American Potash & Chemical Corp., Trona, Calif.

CRYSTALLIZATION may be defined as the formation of a systematically organized solid phase from a solution, melt or vapor. We find extensive application of such processes in the chemical industry.

The principal objective is simply to form a solid phase from a liquid for convenience in later handling; but since there are competitive ways to do this (spray drying, granulation, etc.), generally other more specific requirements are made of the crystallization process.



Most common of these added requirements is purification. Often, impurities can be left behind in the mother liquor, melt or vapor—an effect often taken for granted when a substance is crystallized in a pure form directly from a complex mother liquor. However, purification may indeed be a primary objective as in the recrystallization of a solid to improve its purity, the zone-melting purification of metals or the re-subliming and crystallization from low-boiling solids.

Obtaining material of a given size and shape is another requirement frequently made of the crystallization process. This can consist merely of producing small particles rather than a solid mass, or can include stringent specifications as to uniformity and dimensions. Examples of this second case would range from the production of large, single, perfect crystals for optical and electrical instruments to the production of uniform, cubic, closely sized crystals of table salt.

Still another requirement of crystallization processes is the production of specific physical properties within solids (metals, polymers, etc.). However, this kind of process is not widely used in the chemical process in-



dustries and we'll not discuss it in detail in this report. Production of specific physical properties is often associated with a phase transformation, and often with methods of controlling crystal growth. It can sometimes be brought about by a physical working of the solids, as with wrought iron or polymer filaments; and sometimes by the processing conditions, as in the catalyst selection in forming polypropylene.

However extreme the process conditions to be considered, or however rigid the specifications on the material to be crystallized and the demands made upon the process, crystallization is a widely used unit operation today—and a basic and distinct unit operation. It cannot be logically grouped with any of the other broad unit operations categories.

The mechanism involved is that of a diffusional process; but in other than the most general terms, the analogy with other diffusional operations is poor and the usual mathematical methods cannot be applied (at least at present) with useful results.

Similarly, crystallization cannot be considered as a separation operation, for even though its purpose is to remove ions or molecules from fluids by having them form a new and distinct phase, there is no requirement of separation, or removal of the new phase from the old. This is left for the following step, the purely mechanical operation of separation. Crystallization, in itself, is concerned only with the control of the new phase formation.

Thus, crystallization is a chemical, kinetic and diffusional operation, rather than a mechanical one.

This doesn't mean that we are unconcerned with the mechanical aspects of the equipment involved or that they do not play an important role in the separation operations to follow.

These are the results and tools of the crystallization operation, however, and not its objective. To confuse them with the purpose and major problems of crystallization is to lose sight of many of the fundamentals of a crystallization study.

In becoming fluent with industrial crystallization there are several rather distinct phases that you'll want to master. First comes a thorough knowledge of the mechanism and theory of nucleation, crystal growth and habit modification. Without this, the complexity of the many variables involved, of the sometimes surprising results obtained, and a comparison of the host of commercial crystallizers available become most confusing. Without a thorough knowledge of mechanism theory, you cannot follow an orderly path to process decisions.

Next, a knowledge is required of the most important variables involved and of the laboratory and literature methods available for obtaining the required data and design information.

Finally, you must convert this knowledge into an actual crystallizer design. This again involves close attention to the mechanism of crystallization and a knowledge of the system involved.

You'll also want to be familiar with the mechanical features of a number of crystallizers, and of special techniques that may be used. This, of course, leads to the question: "What will it cost?" As a special feature of this report we have included cost information on crystallization equipment with prices corrected up to the late date of January 1958.

Although written as a comprehensive review of an important unit operation in chemical engineering, this 16-page report brings together in one place much new and timely information found nowhere else in the literature of engineering.



Special Features of This Report . . .



Theory directs design and operation, p. 127.



Let's look at a process, p. 131.



How to design and select equipment, p. 134.



Today's costs, p. 138.

Theory Directs Design and Operation

Although there are no exact formulas or rules, proper design and smooth, economical operation depend on understanding of theory.

MANY facets of modern crystallization theory can be used directly in the design and operation of industrial crystallizers. This doesn't mean that there are exact formulas and rules that can be applied. In fact there are none at all.

Rather, general understanding of the theory and mechanism of nucleation and crystal growth can provide a very useful preliminary guide for industrial evaluation.

The complexity of the variables encountered necessitates some understanding of simplifying principles. There is an extensive literature in the field of crystallization, and though it is far from complete, the general mechanism of nucleation and crystal growth is now reasonably well known. Crystallization can be from a vapor, from a solution or within a solid. Because of the greater occurrence in chemical engineering of crystallization from solution, we shall consider it exclusively in our further discussion.

First Data: Solubility

Every system has an equilibrium solubility relationship that denotes the amount of material that can be dissolved in a solution at a given temperature. Fig. 1 shows several typical examples indicating the effect of temperature on solubility.

Solubility characteristics are the first information that must be known about a system and are often the key to an industrial process.

At this point it's worthwhile considering the micro aspects of solubility and to examine the molecular behavior of the system. A solution that is at its saturation point will, when there is sufficient time and/or seed crystal present for equilibrium conditions to exist, have as many molecules (or clusters of molecules) leaving the crystal as are being absorbed on it. This is a dynamic statistical balance involving essentially the solution concentration, the motion of the molecules resulting from the kinetic energy associated with the solution temperature and the energy of the crystal bond.

With an increase in temperature the molecular motion increases, the "escaping tendency" increases and the solubility rises.

For the less-general case where an increase in temperature causes a decrease in solubility, the explanation must be found in the interaction of the solid with the solvent, such as in hydration. Physically this may be visualized as two separate interactions. At all temperatures the solid would have an adsorbed layer of solvent on it, blanketing the crystal molecules and reducing their escaping tendency. Upon increasing the temperature there would be a decrease in the completeness of the hydration of solute molecules, allowing them a better opportunity to strike the surface and crystallize. Net result is a decrease in solubility with increasing temperature.

This "reverse" solubility, and the varying dependence of temperature on the solubility of all salts, can be explained in a similar manner.

Influence of temperature on solubility may also be predicted by the heat of solution of the crystal. Most salts absorb heat upon dissolving and are more soluble at higher temperatures. Reverse solubility is the rule for salts that give off heat when they dissolve.

Gibbs has shown that the work of forming a second phase within any homogeneous fluid is: $W = 0.33\ \sigma s$; where σ is the interfacial tension and s is the surface area. This equation indicates a change in the total energy of the crystal's surface with particle size and, though small, explains why small particles are more soluble than large particles.

Although measurable only with very minute crystals, experiments have shown that with a mixture of crystal sizes in a slurry, the small crystals will dissolve slowly and the large particles will become larger. This is to be expected since a few large crystals have less surface area, and thus less energy is required to form them than the same weight of smaller crystals.

Solution Stability

When the concentration of a solution exceeds its saturation value, we get supersaturation. Speaking loosely, an unseeded solution may have a certain amount of supersaturation without any perceptible tendency for crystallization to take place.

However, after a higher, "critical" supersaturation has been reached, the solution will nucleate spontaneously and return to its saturation concentration. Ostwald called the first concentration range a "metastable" zone, and the second a "labile" zone.

Considering the numerous variables that affect crystallization, the metastable zone is actually hypothetical for actual industrial systems. The labile and metastable states may always be envisioned to occur, even so, but within supersaturation limits that vary with the immediate crystallization conditions prevailing. Thus, even though not an experimentally determinable factor for other than a few exceptionally precise laboratory conditions, this concept is most useful in design considerations.

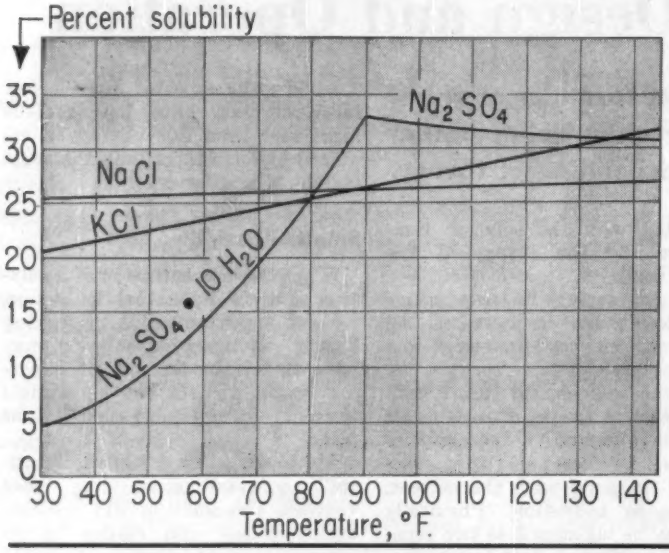
LaMer[1] presents an interesting analogy of the energy state involved in these two zones, as shown (modified) in Fig. 2. The brick A represents the stable or saturated state and conditions beyond brick C the labile state where the solution automatically nucleates. Metastable equilibrium may be represented by a flat corner on the brick, as in B. The extent and stability of the metastable state would be determined by the variable length of this flat.

Starts With Nucleation

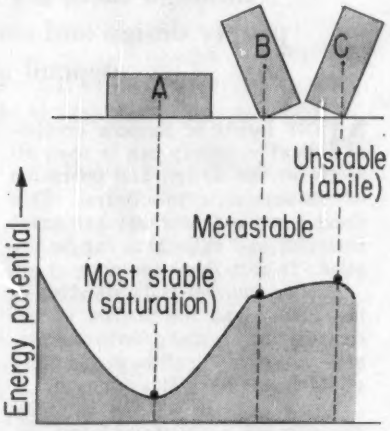
Discussions of the mechanism of crystallization can be subdivided conveniently into considerations of nucleation and crystal growth.

Actually this is an artificial separation, for the phenomenon occur-

Some Typical Solubility Data—*Fig. 1*



Why Supersaturation Exists—*Fig. 2*



ring with crystal growth is merely an extension of nucleation. However, it simplifies the subject to consider nucleation and growth individually. And in some respects the control of an industrial crystallization is best considered on a separate basis.

We can think of nucleation as the formation of a sufficient number of molecules into aggregates until the tendency for further growth is greater than the tendency to lose molecules. The number of molecules necessary to form this critical size apparently varies widely, depending on the compound and the conditions.

Eight molecules have been estimated to be required for $BaSO_4$ and from 80 to 100 for nucleation of water from its vapor.[1] This does not imply that eight molecules of $BaSO_4$ (or 16 ions) have to collide simultaneously to form the critical nucleus, but rather that clusters of various sizes exist in the solution, and that a stable collision only need occur with two clusters that total eight or more molecules.

Both before and after nucleation there is a constant removal and addition of molecules on the nuclei or clusters, so that the presence of any size cluster in the solution follows a statistical distribution pattern that depends on the energy balance and supersaturation of the solution.

The energy required to form a stable nucleus is generally much more than that required to sustain crystallization, as shown in Fig. 3. In structural or molecular terms this curve may be interpreted as the effect of reinforcement of bond strength by molecules more than one lattice space away.

When the molecule is small the attraction is from fewer bonds, the cohesive forces are comparatively smaller and unfavorably large numbers of nongrowth collisions (molecules of the opposite charge or improper energy, etc.) cause a breaking of the bonds.

As the size increases through the occasional favorable collisions, the bonds reinforce each other, the cohesive energy is greater and fewer nongrowth collisions can break up the cluster. Finally a critical size is reached where the reinforced bond strength is such that there is more probability of growth than disruption, and the embryo is statistically stable.

Additional growth continues to add stability and to lower the energy required for crystal growth. However, since the bonds of a given layer have a rapidly decreasing effect upon bonds some distance away, the continuing lowering of bond energy with size, though real, becomes vanishingly small.

In a competitive situation, crystal growth in a seeded solution will thus occur in preference to nucleation. However, the energy difference between nucleation and growth is small enough so that in most industrial crystallizations the two do occur simultaneously. This is especially so in that highly localized conditions of energy sufficient to promote profuse nucleation may easily occur even in slurries.

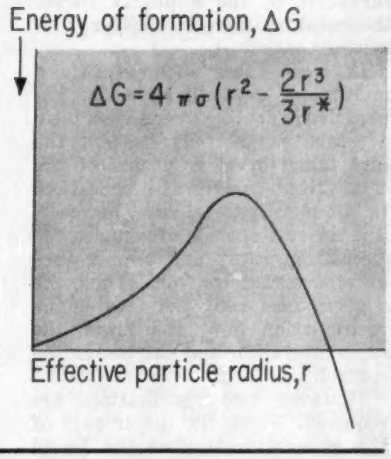
Such localized high-energy or high-concentration zones that can occur at a boiling surface, agitator blades, etc., exemplify the generally small energy differences that are encountered in good crystallization control.

How Crystals Grow

Considerable work has been done on the study of the detailed mechanism of crystal growth. We'll not consider this historically, nor in any detail, but we'll try rather to present a synopsis of current thinking that might be useful in understanding industrial processes. For a more complete review of this subject, we recommend Buckley's book.[2]

In considering the atomic structure of the crystal it's logical to expect that different crystalline faces, and different places on the surfaces, would have different energy levels and consequently different rates of crystal growth. The bonding forces tending to secure new ions or molecules to the crystal have an attrac-

Free Energy Barrier Hinders Nucleation —*Fig. 3*



tion that will vary with the surface geometry. Thus, faces that can be considered as atomic or molecular steps, or high-indices faces, would certainly have a higher attraction for new growth than would flat faces.

Greatest energy location for new growth would be in the corner of the steps, where attractive forces would be present from more than one surface. Also the distance between successive planes of molecules on a stepped face would be closer than on low-indices faces, again resulting in higher attractive force.

For small degrees of supersaturation, it would be expected that the high-indices faces of a crystal would grow preferentially. This is often observed to happen, even to the extent of causing these faces to grow to extinction. With higher supersaturation there is sufficient energy for all of the faces to grow more uniformly.

In a similar manner, on any face, the attractive forces will differ depending on the growth that has already taken place. One would suspect that sites representing corners or holes would be the first to fill, and this is very likely true. However, since we know that the crystallization tendency (energy content) varies widely within the supposedly homogeneously mixed slurry, it's also logical that many of the sites would grow concurrently.

Since molecular clusters of a wide range of subcritical sizes exist within the solution, it's inevitable that many additions to the crystal surface take place by addition of clusters of molecules. This in turn forms more lower energy sites and promotes a rapid growth rate. Such a mechanism helps to explain the surprising rapidity of crystallization and the imperfections and dislocations that occur within a crystal.

Crystals are much weaker structurally than they would be if they were constructed entirely in perfect lattice patterns. Also, more and more studies on the fine structure of crystals have demonstrated that imperfections and areas of discontinuity are more the general case than the exception.

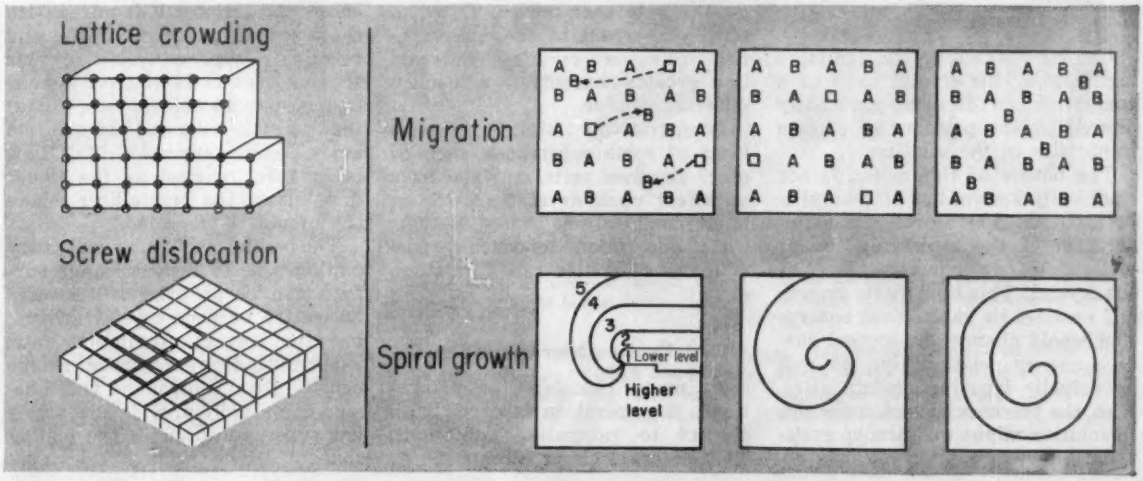
There are many ways that dislocations can start (Fig. 4), such as the overlapping of vacant sites, the crowding of extra molecules or ions onto a surface, the adsorption of foreign particles, etc. Suffice it to say that it can happen easily and once started it tends to perpetuate itself. Formation of the two surfaces (corners) of a dislocation provides preferential sites for new growth.

It's also likely that defects within a crystal help to cause modified growth and strongly influence the crystal's physical characteristics. It likewise would be expected that the degree of supersaturation within a crystallization system and the method of providing for the supersaturation release strongly influence the degree of imperfection of the crystal and the type of dislocations occurring.

With a high degree of supersaturation, where many nuclei are forming or are just ready to form, many comparatively large clusters would attach to the crystal nucleus and odd shapes, such as rosettes, could easily result.

On the other hand, with a very slow release of supersaturation, where deposition would be more by single atoms or small clusters, more perfect crystals should be the ultimate result.

How Crystal Imperfections Start and Spread—*Fig. 4*



Numerous experimental results tend to corroborate this reasoning, for crystal habit (shape) has been observed to be quite dependent on the degree of supersaturation, rate of cooling, slurry turbulence, etc.

In a somewhat similar vein, the formation of long, needle-like crystals or dendrites is attributed to the heat effects accompanying crystallization. Usually a heat gain or release accompanies crystallization. This promotes a configuration that most easily allows a rapid transfer of heat. A long, thin crystal meets this requirement admirably.

A number of other generalities can be made concerning growth rate. It has been noted that the maximum rate that can produce controlled, desired growth on a given surface decreases as the size of the surface increases. In other words, good crystallization occurs over wider supersaturation limits with small- to medium-sized crystals. To obtain larger crystals, much narrower supersaturation limits must be used.

It is also apparently true that ease of growth increases with the solubility of a compound, or with increasing extent of association. For example, NaCl is highly dissociated in solution, has a very small range of supersaturation without nucleation and consequently is very difficult to grow in large or perfect crystals at reasonably rapid rates.

HIO_3, on the other hand, does not dissociate and can readily be grown to large, perfect crystals. Salts that form hydrates usually fall into the "associated" class and crystallize fairly easily.

How to Change Habit

Growth characteristics, and more significantly the crystal habit of a compound, can often be significantly altered by the presence of certain impurities in the solution.

The nature of this action is not completely known, but in general is best explained by a preferential adsorption of the modifying ion or molecule on one or more surfaces of the crystal. This hinders its growth and modifies its habit. Such adsorption would change the normal surface energy relationships, as well as actually blocking certain sites. Also, the presence of such molecules in solution might well hinder nucleation.

If the molecule was adsorbed onto the embryo nucleus, further normal growth would be retarded and the supersaturation required for spontaneous nucleation would be increased.

Raising this metastable range could be a great help in many a crystallization process, as in the case of growing large crystals of KCl. Normally the nucleating tendencies are so great that large crystals can only be formed with slow growth rates. When a lead salt is added to the solution the crystal size is considerably improved, even with comparatively rapid crystallization.

The factors governing which materials will be useful modifiers are not clear. However, it would be expected that a close similarity of bond spacing exists between the compound and the lattice pattern of the crystal, and that comparatively strong polar changes are involved. The atomic spacing need not be perfect, however, and the coincidence is usually only in one plane, or a portion of one plane.

If the coincidence is within a certain limit of exactness, it's possible that the impurity will be covered by the original material, and not alter the habit. If there is enough of the foreign material present and the lattice or atomic spacing is reasonably similar, there may be other interactions such as the original material being seeded by the additive; or the additive may crystallize out as a pseudomorph of the first substance.

The concentration of the additive and the supersaturation of the solution also influence the type and extent of modification of habit and growth rate that occurs. Often, a modifying agent in one concentration will cause a certain change and in a greater concentration, a much different change.

Comparatively high concentrations of some substances, such as other dissolved salts, may also have an effect upon crystal growth or habit modification, owing to their weak adsorption tendencies, possibilities of double salt formation, etc.

About Cyclic Operation

In many industrial crystallizations, the operation is cyclic with respect to saturation conditions. This deserves closer attention.

When a hot, saturated solution is added to an agitated vessel or to a circulating pipeline containing a cooler solution, there is usually a more rapid heat transfer than mass transfer. Also, because of the curvature of the solubility curve, the mixture becomes cooler and supersaturated.

In some cases such as this a multistage crystallization is imperative in cooling over a wide temperature range, regardless of the care taken in other phases of the crystallizer design and operation. In the more general case, however, it is the combination of volumes (or circulation rate) and temperature difference that controls. Thus, for a given feed rate, the greater the recirculation flow, the lower the supersaturation and the better the control.

However, two qualifications are required. First, the major part of the supersaturation of the liquid must be relieved before the cycle starts a second time, or else supersaturation builds up to an uncontrollable extent. Since crystallization is rapid, this requirement can be met easily by adequate volume in the crystallizer and correcting crystal sludge density. A second—sometimes more limiting—qualification is that the increased circulation often results in considerable crystal breakage. This is a very real factor in many industrial processes and if the circulation is too violent, the crystal breakage and formation of fines nullifies the other steps taken for growth control.

In the case of a crystallizer in which boiling takes place, as well as cooling of the feed, two supersaturation cycles occur. As the feed enters the agitator it is mixed with the circulating liquor, cooled, and becomes supersaturated. This supersaturation is relieved as the liquor flows to the surface, but at that point it boils and the solution again becomes supersaturated. This is in turn relieved as the liquor flows down the crystallizer where the process is repeated.

The boiling surface, as well as the mixing zone or heat-exchange surface, can be an area of excessive nucleation or poor crystal growth, but the correct circulation rate, vapor-release area, crystal sludge density, foam control and vessel design can usually provide adequately low supersaturation in the boiling zone.

Study of a Crystallization Process

Here's how to develop the information you'll need for a process study. What to do in the lab, in bench equipment and out in the pilot plant.

EXTENSIVE data are required before the most effective design can be made for any specific crystallization process. First, because of the complex variables involved, it's essential that we define thoroughly the scope and objectives of our process. After this, we may proceed to the technical details.

When the material under consideration crystallizes easily to the desired product, the required technical information is relatively easy to obtain, and there is a wide choice in the equipment that we may use. As the difficulty associated with the crystallization process increases, the quantity of data required for design also increases and equipment choice becomes more limited.

Here is the minimum information required to define the scope of a crystallization study:

- What is required of the crystal: screen size, particle shape, purity, filterability, etc.?
- What existing equipment or facilities must be used, or are available?
- How much time is available for the study and design?
- Are there any special problems involved, such as unusual corrosion or sanitation requirements, extreme pressures or temperatures, radiation; or unusual economic demands, such as a need for a minimum investment, etc.?

Phase Relations, First

A preliminary examination of the system is next in order. For our preliminary study, the most important things to consider are the phase relationships involved in the crystallization. It's very seldom that a single-component solubility curve, such as shown in Fig. 1, will be sufficient.

Co-solutes are always present to a greater or lesser degree. These may cause complications with prod-

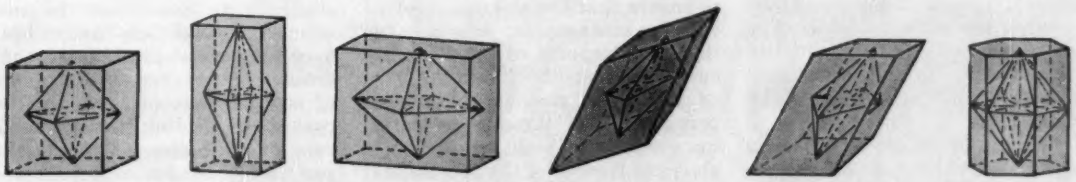
What Crystals Are and What They Look Like

A SOLID is defined as crystalline if there is a high degree of regularity to its atomic structure, and generally if its exterior form is that of a convex polyhedron bounded by plane faces. The interior structure is that of a regular lattice arrangement repeated throughout the crystal.

For ionic crystals the ions may be regarded as charged spheres, each surrounding itself by (and contacting) the greatest possible number of oppositely charged neighbors. Usually the arrangement is the most symmetrical possible. Each compound at a given temperature occurs in only one lattice arrangement. (Actually, this is so over very wide temperature ranges.)

This is the basic law of crystallography: The angles between corresponding faces on all crystals of a given species are constant. But this law speaks of orientation and not of face areas. Face areas vary widely.

Crystals are generally characterized by their symmetry and using a line of symmetry as the reference of three axes, we can classify most crystalline forms into a very small number. Six common types are shown below. They are drawn in both block and pyramidal form.



1. 2. 3. 4. 5. 6.

1. Cubic (regular or isometric). Three axes of equal length intersecting at mutually right angles to each other.

2. Tetragonal. Three axes intersecting at right angles. Two axes are equal in length; but the third axis is either longer or shorter than the other two.

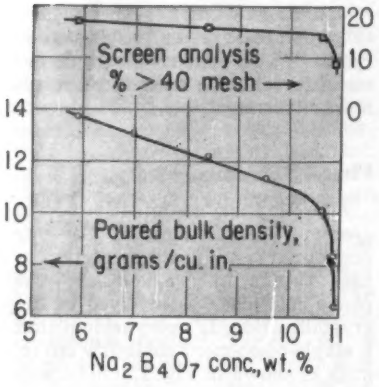
3. Orthorhombic (rhombic, prismatic). Three axes of unequal length which intersect at right angles.

4. Monoclinic. Three axes of unequal length, two of which intersect at right angles while the third axis is perpendicular to one and not perpendicular to the other.

5. Triclinic (anorthic, asymmetric). Three axes of unequal length, no two of which intersect at right angles.

6. Hexagonal. Three axes of equal length in the same plane and intersecting at 60-deg. angles. A fourth axis is either longer or shorter and at right angles to the other three.

Lab Tests Spot Decreasing Crystal Size—*Fig. 5*



uct purity, habit (shape) modification or, perhaps, even with the overall operation.

For each system, therefore, it's desirable to obtain as complete a solubility diagram as possible, including each of the substances that may be present. Several specific references on phase diagrams[3, 4, 5] provide comprehensive solubility data.

However, for systems that are at all complex, it's usually necessary to determine the solubility diagrams experimentally.

When you have phase diagrams available, the crystallization process may be delineated. For a substance that has a moderate or rapidly increasing solubility with increasing temperature (KCl, for example), usually a process based on cooling the solution is best. For a substance with a flat solubility curve (NaCl), crystallization may be most easily accomplished by evaporation.

Usually, the value of the salts present in a mother liquor following a crystallization step is too great to allow the liquor to be discarded, so at least part of the mother liquor should be recycled to the front of the process. Often this can be done without complication, but sometimes the recycling and building up of the impurities will substantially change the crystallizing conditions.

When recycling or using a minimum bleed, you should also consider that the more concentrated impurities may change the crystal habit or growth rate of the desired crystal, sometimes so much so that a different operation may be required. Therefore, determining the most favorable or economical conditions, based on the phase relationships, may represent a complex study.

It is often the key to the entire process.

Heat and Material Balance

A second preliminary study that must be made at this point is a quick heat and material balance around the system. Heat is usually evolved during crystallization; but of more importance, often large heating or cooling loads are required to manipulate the solution temperature and the solubilities of the product.

Unfortunately, very few data are available for detailed enthalpy balances. But reasonable accuracy may be obtained by considering the heat of crystallization, the latent heat of vaporization and by estimating the sensible heat. For sensible heat you can assume that $C_p = 1/\rho$ if other data are not available. Units are: C_p = Btu./lb.-deg. F.; ρ = solution density in grams/cc. Heat of dilution may be ignored in most cases.

For a large operation with a complex system it will sometimes be worthwhile to determine experimentally an enthalpy chart of the temperatures and concentrations involved.

The normal practice of working out a material balance for the process has no special significance in a crystallization study other than to ensure that the slurries involved will be manageable. It's possible that the steepness of the solubility curve, the amount of seed required or the large amounts of solvent being removed through hydration or evaporation will result in a slurry at the end of the process that is too thick to handle. If such a condition exists the system can usually be modified to correct this.

Watch for Scaling

As a final point in the preliminary study, some thought should be given to scaling or decomposition characteristics of the crystals or liquor. The very fact that a solid phase is forming from the solution implies that some solid may adhere to the vessel walls or the heat-exchange surface.

If the effect of temperature on the solubility curve of the salt is such that saturation is greatest at the exchanger or vessel walls, then scaling is accentuated.

It's also quite possible that the greatest scaling might occur from a material that is a minor constituent in the system, such as gypsum (with its reverse solubility) in heater tubes within an NaCl evaporator-crystallizer.

Some scaling during crystallization is unavoidable, but the degree can be controlled over wide limits with different operation and with different equipment. Often it's decided to accept whatever scaling occurs and to remove it periodically, but the economics involved must be considered carefully in a preliminary design.

With the requirements of the system determined and the preliminary study completed, the process and the equipment that can be considered are reasonably well defined. For a thoroughly studied raw material, final designing may then be started. But this is the exceptional case.

Almost always there is sufficient uncertainty as to the exact crystallization characteristics of the material so that some experimental data are required. This may vary from a few quick pilot-plant checks (often done in an equipment manufacturer's facilities) to a rather elaborate research program.

Get Thee to a Lab

The purpose of an experimental study is to determine the most economical conditions that will produce the desired product. If a preliminary study has fixed the type of equipment to be used, this will consist of finding the maximum rate of formation of the product per unit time, per unit volume of crystallizer that will produce the required crystal.

In other words, what is the maximum extent—and thus rate of relief—of supersaturation that can be tolerated? For many types of equipment this can be established fairly quickly, for the interrelation of optimum operating conditions is well known. A brief series of runs in a small pilot plant will come satisfactorily close to defining the optimum conditions.

For the more difficult crystallization we have quite a different case. Many times the conditions of supersaturation release, agitation, habit modifiers, etc., are so specific or expensive that a satisfactory process can only be determined by a detailed test program. The first problem in such a program is to establish rapid and reliable test methods. Extensive screening experiments are best conducted on a batch basis in the laboratory using small quantities and simple equipment.[6]

Controllable agitation is necessary, with gentle—but thorough—stirrers that can be operated at variable, known rpm's. Concentrations and methods of reaching supersaturation must be precise and repeated exactly for each run, as must be the techniques of seed addition.

There are many ways to compare the results of comparative crystallizations, the most general being screen analysis. Photomicrographs are also useful. Less common but also useful tests are a measurement of a crystal's "pour" bulk density of a given screen size, and a shatterability test such as milling with steel balls on a screen in a shaker for a specified length of time. Such tests will provide a good measure of the crystals' size, shape, hardness, degree of agglomeration and uniformity.

Determination of the allowable supersaturation is one of the most important variables to be studied, generally by examining varying initial concentrations and feed temperatures, and cooling to a fixed terminal temperature in a given length of time.

Variations can be obtained by changing the temperature range of cooling, or by changing the rate of cooling. Next in importance is often a study of the amount of seed, if any, that is required. For a material that crystallizes sluggishly, the time to relieve supersaturation is a function of the amount of seed present, with large quantities (10 to 40 wt. %) sometimes required for rapid crystallization.

Also, for most materials, the amount of seed that has been added has a very direct relationship to the screen analysis of the product. The greater the area of seed present, the less the tendency for nucleation, and the greater the growth on the crystals.

This does not imply that a high seed density automatically allows one to control nucleation, for as explained previously, the variation of energy within a commercial system (from agitation, boiling, etc.) can easily cause nucleation no matter how much seed is present. A high seed density is sometimes even harmful to the growth of large crystals, for attrition that takes place within a crystallizer is a real factor and the fragments resulting can be so numerous that it's impossible for any particle to grow to a reasonable size.

However, in most cases for seed densities up to a comparatively high limiting size, increased seed allows better process control, and is a factor well worth investigating.

If the desired crystal size or shape cannot be obtained within reasonable limits of the above variables, it may be desirable to test the effect of modifying agents. This is of necessity a trial-and-error procedure, even though lists of agents that have been effective are available.[7] The odds of finding a successful modifier are somewhat poor, but many spectacularly successful cases are known.

There are numerous other process variables that can be screened in a laboratory study, such as: the sensitivity of a solution to nucleation by agitation or at a boiling surface; effectiveness of salting-out with organic solvents; or the use of ultrasonics. The advantage of laboratory studies is their speed and relative cheapness. They are, however, limited in scaling up the data to final design. Often bench-scale and/or full-scale pilot plants will be required.

Pilot-Plant Studies

The expense of any pilot plant makes the use of smaller bench-scale equipment attractive under the correct conditions. This equipment may replace much of the laboratory and pilot-plant study when certain continuous crystallization processes are envisioned.

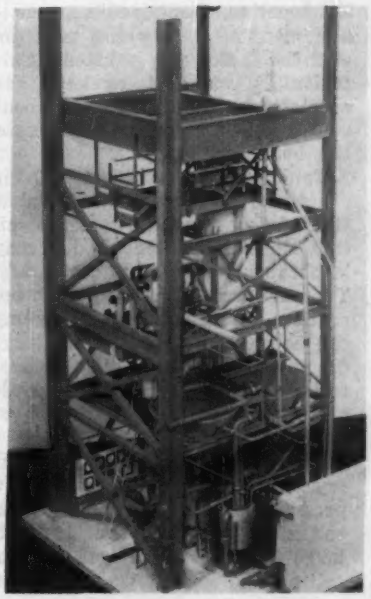
Their best use is to simulate stirred-tank systems, but they may also be used to test some of the variables in a proposed evaporative crystallizer. However, to be effective in obtaining data, they must always be constructed as agitated-tank units because of the demand for simplicity on this small scale.

Variables such as the required residence time for fixed inlet and operating temperatures (allowable feed rate), the optimum feed and discharge temperatures, the optimum sludge density (seed return) and the advantage of multistage operation can be readily examined on the laboratory bench.

Large pilot-plant crystallizers allow considerably more accurate study, but their expense limits their use. For crystallization processes using evaporation and operating at temperatures well above ambient, heat loss and salting problems require good-sized pilot plants—12-in.-dia. bodies being an almost absolute minimum.

For ease of operation and assurance in the final scale-up of large or difficult systems, 4- to 5-ft.-dia. bodies become quite necessary. These pilot plants with all of their accessories are very large and expensive units, and can only be justified in unusual cases. In their place it's common practice for equipment manufacturers to do much of their experimenting in cautious new designs on new construction or in modifying old production units.

Evaporator-Crystallizer Model —*Fig. 6*



How to Select an Equipment Design

This rundown on what's available in today's equipment market won't make you an expert. But it will start you in the right direction.

HERE are the broad classifications of commercial crystallizers that are available in today's market:

- Agitated-tank crystallizers.
- Forced-circulation crystallizers.
- Growth-type crystallizers.
- Mechanical crystallizers (scraped-wall, etc.).
- Special-purpose crystallizers (fractional crystallization, growth of very large crystals, etc.).

Equipment in each category may be operated either batch or continuous and most may be operated with or without evaporation accompanying the crystallization. In this classification scheme and in our discussions below, equipment which is now obsolete—even though still in use—will be given only brief consideration.

Agitated-Tank Systems

Simplest of crystallizers is the agitated tank, used principally for cooling hot saturated solutions. The tanks may be open or enclosed, and made of various materials of construction. Cooling coils are usually mounted within the tank, or else the tanks are jacketed. Agitation is sufficient to keep the crystals suspended, the liquor concentration uniform and to increase the heat-transfer rate.

Tank crystallizers are useful for comparatively small-scale production, such as with organic chemicals, since an excellent product may be obtained and the first cost is low. They are well adapted to batch operation, where the rate of cooling can be controlled to produce large crystals even with difficult materials. Also, the relatively gentle agitation minimizes breakage of fragile crystals.

Obvious disadvantages of tank crystallizers are their very slow production rate (low heat-transfer coefficients), the comparatively large floor space required and the salting and scaling problems. The cooling surface becomes rapidly encrusted with salts, greatly diminishing the rate of crystallization and necessitating frequent salt removal.

In some cases a small quantity of steam or hot water sent through the coils in place of the coolant will serve to remove the deposits. In other cases there may be a convenient dissolving liquor available to remove the scale (such as the feed liquor in a batch operation), but generally a separate wash-out is required.

There are some examples where agitated-tank crystallizers are being used effectively in continuous processes, as in the crystallization of NaCl from hot concentrated caustic solutions. Here the agitation is achieved by a series of slow-moving vertical blades that pass very close to coils located only a foot or so away from the walls of the vessel (Zaremba Co.). The turbulence created near the coils thus improves the heat-transfer rate and decreases the rate of salt deposition on the coil. As an added feature, salt is made to move up slow spirals behind the coils, aiding in crystal growth and salt removal. The period between wash-outs in these crystallizers is greater than in normally agitated units.

As a second example, glauber salt is crystallized from a brine by one company in continuous tank crystallizers equipped with highly polished stainless steel cooling coils. A series of vertical tube bundles are inserted into the tank and vigorous agitation is supplied. It has been claimed that the period between wash-outs can be extended from the original 2 days to about 6 days, provided there are no imperfections left on the tubes during their fabrication and installation.

Forced-Circulation

Without special circumstances, however, or unless the production is very small, the agitated-tank system is usually not the best selection for most economical design.

Figs. 7 and 8 represent two kinds of forced-circulation crystallizers that are used commonly. The reasons for the forced circulation are:

- To control the supersaturation release.
- To reduce salt deposition on heat exchangers and the crystallizer body.

The feed solution is added to a large volume of circulating liquor so that the supersaturation that it possesses at the temperature of the crystallizer is "diluted" into a large solution volume. When a heater or cooler is involved (Fig. 8), the large amount of circulating liquor allows only a small temperature change, which produces a low supersaturation per pass and greatly reduces the salting-out tendency.

Both factors contribute to a more efficient and more closely controlled crystallization.

The pachuca-type unit of Fig. 7 is a simple and efficient crystallizer that may be used for evaporation-crystallizations. Internal agitation is generally more efficient than an external pump and it allows lower purchase and maintenance costs. However, these factors are still comparable to those of the more conventional exterior - circulation equipment.

Operation may take place at any reasonable pressure and conventional condensers and vacuum producers may be used. The unit shown in Fig. 7 is equipped with a barometric condenser using a colder brine as the condensation medium. Such a system, if the cold brine is available, allows a very close boiling liquor-injection liquor temperature approach, for boiling point rises cancel out.

It's sometimes convenient on high-vacuum systems to use several crystallization stages, with an ammonia condenser on the final stage and the product filtrate as the barometric liquid on the first stages.

The conventional exterior-circulation crystallizer (Fig. 8) is more versatile than the pachuca, for it may use an external heater or cooler besides being used as an evaporator - crystallizer. Modern

designs use low-pressure-drop (6 to 15 ft. of flowing fluid) circulation systems and slow-speed, low-head, high-capacity pumps. Usually these are axial or mixed-flow (in the line) pumps with energy efficiencies of from 70 to 85%.

Heaters or coolers are single-pass whenever possible. And care is taken to have the minimum length of circulation line, as well as low-head-loss inlet and discharge connections to the crystallizer body. Velocities in the exchanger tubes are kept as low as is consistent with high heat-transfer coefficients and slow scaling (usually, 5 to 7 ft./sec.).

In this manner, even with large recirculation flows, the power requirement is kept small—a necessity for economical operation.

Considerable attention is also given to factors that produce good-sized, uniform crystals. Control of supersaturation is the most critical factor, with temperature rises or drops through the heat exchanger limited in many cases to from 4 to 8 deg. F. This depends on the steepness of the salt's solubility curve and its hypothetical metastability limits. For difficult cases, the coolant-to-circulating-liquor temperature difference is kept low.

For example, in crystallizing both sal soda and glauber salt, log mean temperature differences greater than about 12 deg. F. begin to cause rapid tube fouling.

Good evaporator-crystallizer designs hold the liquor level very carefully, by instrument control, just above the entry pipe with the depth being slightly different for tangential, radial, central through a diffuser plate—or a combination of these types of entry.

It's hard to choose among the various re-entry methods, for each can be effective if correctly adapted to the size of the vessel and the specific problems of the system involved. A poor re-entry design can lead to excessive nucleation and salt buildup in the vaporizer.

Numerous other construction details should be carefully designed for optimum crystallization. But perhaps only one other is highly critical. That is the provision for steady and consistent operation that only instrumentation can supply.

Needed are: accurate temperature control; flow rate and liquid-level control; and, if possible, concentration control. This is the minimum instrumentation to guarantee steady, not cycling, operation—one of the first prerequisites of good crystallization.

In summary, the forced-circulation crystallizers are capable of giving good crystallization control and a good product at reasonable first and operating costs. They have a high capacity per unit floor space and volume, but they are seldom capable of producing large crystals.

They are the work horses of the modern crystallizers and should usually be thought of first in any crystallizer design problem.

Growth-Type Units

When fouling conditions are severe, or when very large crystals are required, a somewhat special crystallizer design is necessary.

Generally, this is a forced-circulation unit as discussed in the section above, but with special attachments and differing capacities. By lowering the rate of feed into such a unit, it's often immediately capable of producing large crystals; but other features are many times necessary and desirable.

Two typical growth-type crystallizers are shown in Figs. 9 and 10. They are forced-circulation units, but differ from the simpler variety in that sludge density may be controlled within the crystallizer body, and in having a built-in crystal size classification system. Two product streams are always withdrawn from the units: a heavy sludge containing the crystalline product; and a relatively clear overflow liquor.

By adding an external classification and sludge-return system to a normal forced-circulation crystallizer, much the same results can be accomplished.

The pachuca-type growth crystallizer of Fig. 9 can have a settling area on the sides as shown, or if it is not operated as an evaporator-crystallizer, the settling zone may be on top of the circulation section. In such a manner the sludge density may be built up to any desired level without the external addition of salts.

A large commercial example of this latter type of crystallizer is shown as the frontispiece for this report. This unit is used to crystallize borax from a superstaurated brine solution. The pachuca agitator is bottom-driven and maintains a vigorous circulation of an approximately 25-wt.-% borax sludge in the bottom of the crystallizer.

The saturated feed solution enters at the suction to the agitator, a sludge is drawn off from the bottom and a relatively clear overflow is taken off the top conical section. The high sludge density maintained in this unit has the additional function of greatly speeding an otherwise sluggish crystallization.

We've shown the "Oslo" or "Krystal" type crystallizer in Fig. 10. This unit also uses the feature of classification and controlled sludge density, but has a separate suspension chamber. In the case of an evaporator-crystallizer only one vessel is required.

When the capacity of the unit is small, the suspension chamber is occasionally made large enough so that most of the crystals are just suspended by the upward flow of circulating liquor and a fluidized bed exists. This provides a favorable environment for the growth of large crystals, since the supersaturated solution passing through the crystal bed allows slow, uniform crystal growth.

Ideally, only crystals of the desired size are removed from the bottom of the suspension chamber, all others being retained until they are of the correct size. Since the mother liquor may be withdrawn as a clear overflow from a settling zone in the top of the suspension chamber, the slurry density may be controlled at will.

Because the settling rate of the crystals is comparatively slow in most systems, it's usually the case that the crystals are not suspended in the lower chamber but are actually circulated completely through the exchanger and vaporizer. If this were not the case the circulation rate would be so low that an excessive temperature change would occur in passing through the heat exchanger. Alternatively, the suspension chamber would have to be very large.

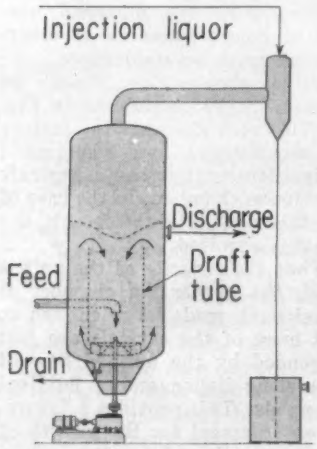
As a consequence, the generally complete circulation of solids makes these units similar to other growth-type crystallizers despite their unique appearance.

Growth-type crystallizers are also often very effective for crystallizations involving extreme salting or scaling problems. Their design is based upon the very careful control and slow release of supersaturation,

Crystallizers

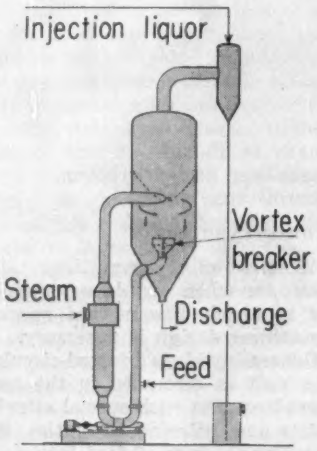
Pachuca-Type Forced Circulation

Fig. 7



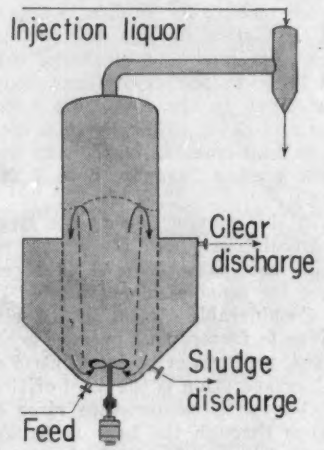
Conventional Forced Circulation

Fig. 8



Pachuca-Type Growth Circulation

Fig. 9



which is the same control needed to minimize salting.

For example, if only a small supersaturation is effected in the circulating liquor passing through the heat exchanger, and if this supersaturation is essentially removed in the crystallizer body before the liquor is again recirculated, there is comparatively little tendency for salts to deposit in the tubes.

Similarly, if in an evaporator-crystallizer the liquor is very mildly supersaturated when it contacts the walls, the tendency for salt buildup in the vaporizer area is greatly reduced. Such control can be worth money in a crystallizer operation, for if wash-out schedules can be lengthened or eliminated the operating and first costs can be greatly reduced.

The first cost of growth-type crystallizers is higher than that of conventional units. But, in summary, they are generally capable of growing much larger crystals and are more versatile. Many crystallization problems cannot justify the expense of growth units; but a surprising number can. The appearance of a crystalline product, including its uniformity, lack of dust or fines, free flowing ability, high bulk density, freedom from caking, and purity, is very important in customer acceptance. With a competitive product these factors can be a strong asset, if not a requirement.

Mechanical Crystallizers

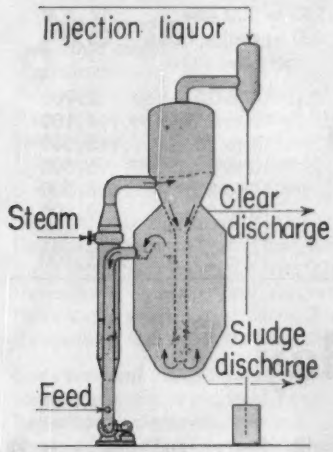
Considering the special problems encountered in many crystallization processes and the normal evolution of the technology of crystallization, there are literally hundreds of crystallizer designs used by industry today. Many of these are obsolete or contain relatively minor deviations from designs previously discussed. One general category that does warrant further discussion, however, is the mechanical crystallizer, classified on the basis of the mechanical motion used to aid the crystallization. Scraped-wall coolers, high-speed rotating jacketed vessels, etc., come under this heading.

Several crystallizers of this kind have been until recently very widely used. The Wulff-Bock crystallizer was installed extensively abroad, particularly in the crystallization of KCl. It is a baffled, natural convection-cooling, rocking trough. The liquid cooled as it slowly passed through the trough, producing large and uniform crystals.

The Swenson-Walker crystallizer in this country is somewhat similar, being a jacketed trough with a slow speed spiral agitator rotating in close clearance with the walls. Scraping action of the screw allows only a thin layer of salt to deposit on the walls and keeps the crystals partially in suspension. Comparatively large, well-formed crystals result. Both of these units produce a good product, but they have a very low capacity and are mechanically complex. Other types of crystallizers would be preferred in a new installation, except under very special circumstances.

One type of mechanical crystallizer that is currently in use for special problems is the scraped-wall crystallizer shown in Fig. 11. It is used in the crystallization of wax or paraffin from petroleum stocks, and in a few inorganic applications. The liquor to be cooled flows through an inner pipe that is jacketed by a second concentric pipe or a larger shell containing the coolant. Slow-speed scraping blades

Growth Oslo-Type *Fig. 10*



run the length of the inside pipe, scraping off the crystals as they are deposited. Standard size is a 6-in.-dia. pipe, 34- to 44-ft. long.

Very often these units will be arranged in large multiple banks in parallel and series to provide the necessary capacity. Cooling may be provided by the vaporization of ammonia or by circulation of a liquid.

These units provide a positive heat transfer in cases where extreme fouling or a semi-immobile slurry is encountered. Also, very high temperature differentials (usually greater than 30 F.) from the coolant to the crystallizing liquor may be utilized, since there is no worry of fouling the heat transfer surface. This helps to reduce the surface area required, and partially compensates for the medium-low heat transfer coefficients obtainable (30 to 150 Btu./hr.-sq. ft.-°F.

However, the units are more expensive to operate than other crystallizers (they must be washed out fairly frequently, etc.) and have a high cost per unit area, so they are primarily for those difficult problems that cannot be handled in conventional equipment.

Among the other mechanical varieties is the Votator crystallizer, a double-drum unit with the inner drum rotating rapidly and the liquid flowing through the annulus between the two. The outer drum is jacketed and may be cooled, giving rise to moderately high heat transfer coefficients (150 to 300 Btu./hr.-sq. ft.-°F. These units provide rapid cooling and have a small liquor holdup. Their capacity is small, however, and they are generally expensive, again limiting their application to special problems.

Special-Purpose Units

There are many special crystallization problems that require somewhat different crystallizer designs.

Growth of large, perfect crystals for optical or piezoelectric use requires rather special equipment. Here the crystallization must be extremely slow and uniform, giving rise to special methods of supersaturation control (feed addition), agitation, and crystal support. Small, laboratory size, highly instrumented, agitated vessels are usually employed with single seed crystals suspended in them.

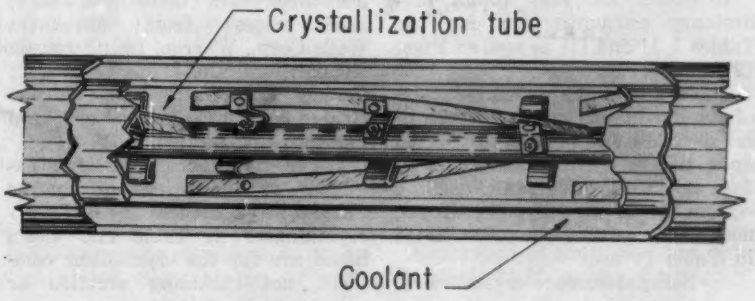
Often, specific crystal planes are needed, so the shape of the crystal must be controlled to develop the desired faces. This may call for chemical modification of the solution, and usually cutting of the seed crystal to a shape that will implement the desired growth.

A second type of special crystallization is known as zone refining. This might be considered as one case of the more general term fractional crystallization, in which a medium purity crystal is transformed into a high purity portion and a fraction containing the residual impurities. With zone refining, a solid shape is melted in a narrow zone that progressively moves down the crystal. All other sections of the crystal, except the zone, are kept solidified. The impurities tend to stay with the melted portion, and after repeated re-meltings are slowly concentrated in the lower section. Extremely high purities are obtainable in the upper sections.

Numerous mechanical devices have been proposed to accomplish a similar objective in slurries or with low-melting-point crystalline mixtures. Cooling (crystallizing) and heating (melting or redissolving) zones are connected by conveying equipment to allow numerous re-meltings or re-dissolvings of the solids in progressively purer zones of the unit. The principle involved with such machines is excellent, but mechanical complexity and only semipositive action have prevented their being commercially used.

A final example of special crystallizers is that in which the crystallization immediately accompanies, or is brought about by, either salting out or a chemical reaction. Both methods are in common use, and although crystallization theory applies and much of the standard equipment can be used, the problems are nevertheless somewhat different. In general the control of supersaturation becomes much more difficult, and the crystal size tends to be relatively small unless agglomeration fortuitously occurs by itself.

Mechanical Crystallizers Solve Special Problems—*Fig. 11*



Estimated Costs for Mechanical Crystallizers—*Table I*

General Type	Description	Horsepower	Heat Exchange Area, Sq. Ft.	Approx. Heat Transfer Coeff.	Approx. FOB Price, $
Scraped-surface with 6-in. cryst. tube, carbon steel; 8-in. jacket, 44-ft. long.	1 section	1.0	70	30 to 150 (use	3,700
	4 sections	3.0	280	50 as design basis	11,800
	8 sections	7.5	560	for inorganic salts)	21,000
Rapidly rotating concentric-drum crystallizer.	Carbon steel	25	60	150 to 300 (use	17,500
	316 stainless	25	60	200 as design basis, inorganic salts)	26,000
Swenson-Walker with operating volume of 24.6 gal./ft. of length.	Carbon steel, 10 ft	2 to 5	35	10 to 25	2,900
	Carbon steel, 20 ft	2 to 5	70	10 to 25	4,100
	Carbon steel, 30 ft	2 to 5	105	10 to 25	5,300
	Carbon steel, 40 ft	2 to 5	140	10 to 25	6,500
	316 stainless, 10 ft	2 to 5	35	10 to 25	6,500
	316 stainless, 20 ft	2 to 5	70	10 to 25	9,300
	316 stainless, 30 ft	2 to 5	105	10 to 25	12,300
	316 stainless, 40 ft	2 to 5	140	10 to 25	15,100

What Crystallizers Cost Today

Ask the man who buys equipment from several manufacturers to tell you how much he pays. Here's what he'll tell you about costs.

GENERALIZED charts for preliminary estimation of crystallizer costs are difficult to prepare because most crystallizers are custom made for specific jobs. Also, widely varying accessories go with the simple crystallizer body, and differing demands upon crystal size and heat loads complicate any general reference to size.

This is especially true when you try to compare different types of crystallizers. The only completely satisfactory way to compare costs is to contact equipment manufacturers with each specific problem. By obtaining rough estimates from several manufacturers of each type of crystallizer under consideration, reliable economic equipment evaluations can be made.

However, for very rough preliminary estimates you can use Tables I, II and III as well as Figs. 12 and 13.

Table I lists the estimated costs of standard units of a few mechanical crystallizers. These are based upon the bare equipment costs of January 1958. Companies selling equipment of this type (but not necessarily quoting the prices listed in Table I) are:

• Scraped-surface crystallizers: Worthington Corp., Harrison, N. J.; Henry Vogt Machine Co., Louisville, Ky.

• Rapidly rotating concentric drum: Girdler Co., Louisville, Ky.

• Swenson-Walker: Swenson Evaporator Co., Harvey, Ill.

Table II gives examples of the cost of forced-circulation and growth-type crystallizers for several specific problems. Complete equipment costs are given, except for instrumentation where noted separately. No installation or freight costs are included. The tabulated data include heat exchangers for the evaporator-crystallizers and the cooler crystallizers; also include vacuum equipment for all but the cooler crystallizers.

Costs are actual bids from the past three years (factored to Jan. 1, 1958 prices) from: Struthers Wells Corp., Warren, Pa.; Swenson Evaporator Co., Harvey, Ill.; Conkey Equipment Div., Chicago Bridge & Iron Co., New York; and Zaremba Co., Buffalo, N. Y.

We've given some additional examples of the prices of specific "Krystal" (Struthers Wells Corp.) crystallizers in Table III. Costs listed are for the crystallizer complete, not including erection or freight. Slurry and magna tanks are not included. Prices were quoted as of March 1958.

Some of these tabulated data, such as the Swenson Walker crystallizers of Table I, may be used in economic evaluations with fair assurance of accuracy, but the remainder can be used only for very preliminary estimates.

However, since a first-order-of-magnitude estimate might be useful occasionally, we have prepared Figs. 12 and 13. Fig. 13 will allow accurate estimation (especially for the pachuca growth-type crystallizer), but since the costs are for essentially the body only—and with the reference in terms of body diameter—you must design the equipment and estimate the auxiliaries before you can get a cost for any particular job.

For more immediate use, but with much less accuracy, we recommend the use of Fig. 12. Because of the widely fluctuating requirements for crystal size and the auxiliaries (heaters, vacuum equipment, etc.), the cost of crystallization equipment to produce a given tonnage per day may vary widely—actually even more than the bands shown on the chart. Only the conventional forced-circulation and the Oslo growth-type crystallizers have been included in the plot; the pachuca forced-circulation type crystallizers would be similar but slightly

Costs of Forced-Circulation and Growth Crystallizers—*Table II*

General Type and Description	Capacity, Tons/Day	Crystal Size, Mesh	Complete, FOB Price, $	Instrumentation, $
Growth-Type, Oslo				
Two-stage evaporator-crystallizer, mild steel construction.	15	60%+50; 90%+50	22,000	4,500
Single-stage evaporator-crystallizer, mild steel construction.	10	Large	22,500	10,000
Two-stage cooler crystallizer, mild steel construction.	85	50%+40; 95%+100	100,000	———
Three-stage vacuum crystallizer, mild steel	235	95%+50	100,000	———
Three-stage vacuum crystallizer, 316 stainless	235	95%+50	210,000	———
Three-stage. Vacuum crystallizer first stage; ammonia cooling second and third stages; 304 stainless steel construction.	520	90%+40	343,000	———
Growth-Type Pachuca				
Three-stage vacuum crystallizer, rubber-lined	390	98%+80	143,000	———
Three-stage vacuum crystallizer, 316 stainless	390	98%+80	200,000	———
Three-stage vacuum crystallizer, rubber-lined	390	98%+30	159,000	———
Three-stage vacuum crystallizer, 316 stainless	390	98%+30	205,000	———
Three-stage vacuum crystallizer, 316 stainless	130	98%+80	68,000	———
Conventional Forced-Circulation				
Single-stage vac.-cryst., mild steel	30	———	31,000	———
Two-stage cooler-cryst., cast iron	80	95%+100	50,000	1,500
Single-stage vac.-cryst., rubber-lined	120	90%+100	43,000	———
Three-stage vac.-cryst., mild steel	550	———	154,000	———
Triple-effect evaporator-crystallizer, mild steel, stainless heaters.	5,000	———	1,900,000	———
Quadruple-effect evaporator-crystallizer steel with stainless heaters.	5,000	———	2,700,000	———

Some Examples of "Krystal" Crystallizer Costs—*Table III*

Capacity, Tons/Day	Construction Materials	Crystal Quality	Type of Unit	Equipment Cost in $/Ton of Crystals Produced Each Hour: Unit Proper	Vacuum Equipment	Instruments
Over 500	Steel and cast iron	90% on 50 mesh; less than 1% through 100; Ratio of L/D: ¼	Vacuum crystallizer	5,000	700 (partly stainless)	———
Over 100	316 ELC stainless	90% on +40 mesh; less than 1% through 100; Ratio of L/D: ½	Vacuum crystallizer	8,000	275	350
About 30	316 ELC stainless	90% +40 mesh; less than 1% through 100; Ratio of L/D: ½	Vacuum crystallizer	29,000	700 (cast iron)	4,400
About 6	316 ELC stainless	Food chemical; 95% 40 to 50 mesh; less than 1% through 100; Ratio of L/D: ½	Evaporator-crystallizer	180,000	5,000	———

cheaper than the former; and pachuca growth-type crystallizers would vary in price between the two types shown.

Cost data have not been listed for agitated-tank crystallizers, since the costs for the tank and agitator are readily available from standard cost-estimating references, and the cost of cooling coils depends on the heat load of the particular system. Since cooling coils are relatively simple to design, their cost may also be estimated from standard references on cost estimation.

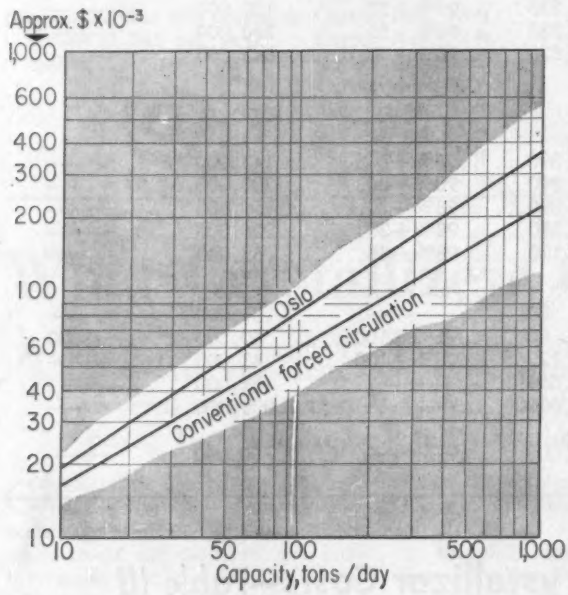
In case you require polished tubes, the approximate cost for a ground and highly buffed finish on the outside of stainless steel tubes is about $1.00/sq. ft. of tubing.

REFERENCES

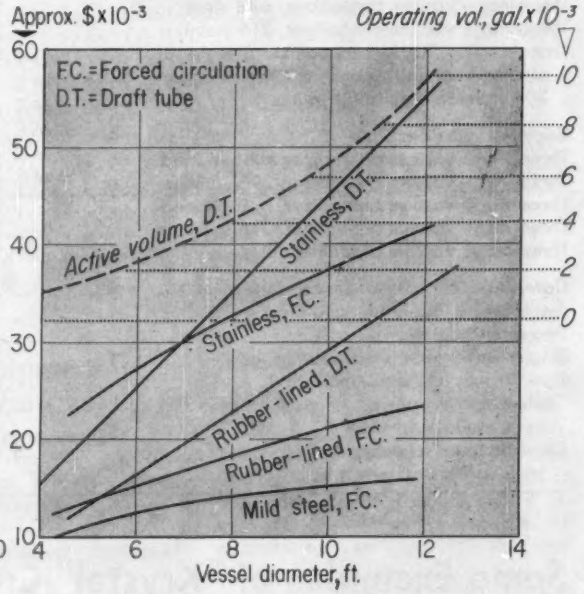
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1958 Crystallizer Costs

For Quick Estimates—*Fig. 12*



For Final Decisions—*Fig. 13*



Meet Your Authors



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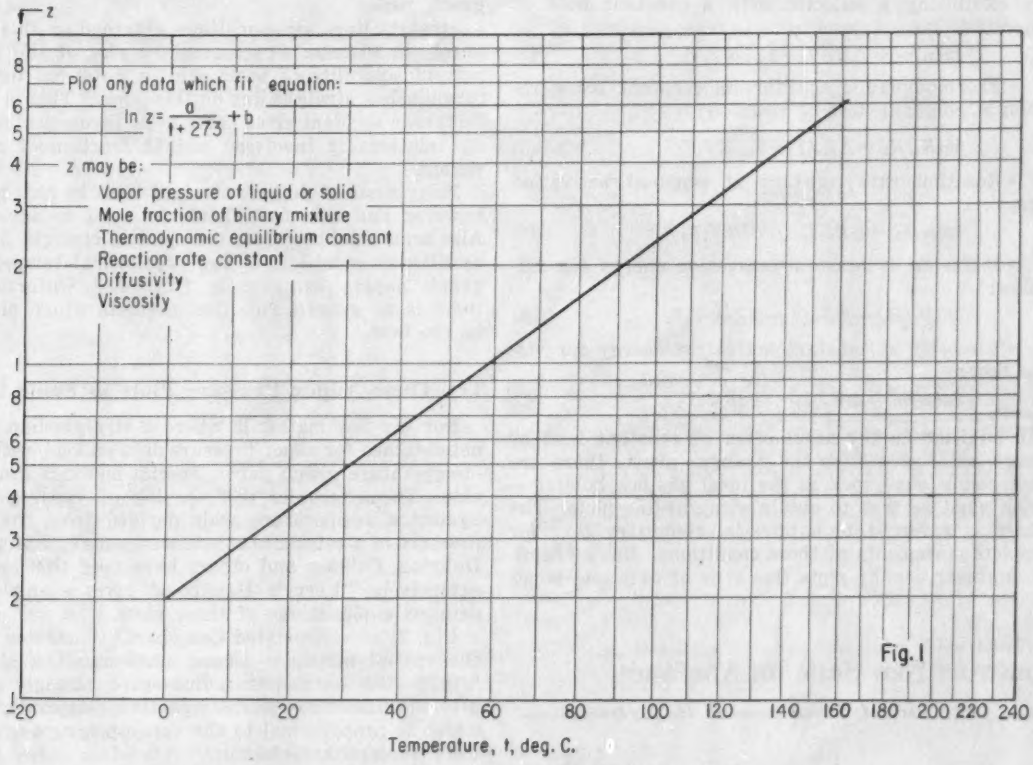


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He is a senior research engineer with American Potash & Chemical Corp. at Trona, Calif. Most of his time is dedicated to the analysis of crystallization processes, especially those that involve binary and ternary solutions. He was employed by W. R. Grace and the Du Pont Co. before joining Ampot in 1956. He holds a Ph.D. from Vienna Univ.

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Log—Reciprocal-Temperature Paper Saves Time by Plotting Temperatures Directly



Unusual Graph Papers and Their Uses

You should get to know these log—reciprocal-temperature, triangular, probability and reciprocal graph papers better.

GERALD A. LESSELLS, U.S. Industrial Chemicals Co., Cincinnati, Ohio.

Following last month's review of common types of graph papers and some of the conventions and technics of graph plotting, this concluding article describes uses and tricks of several exotic types of papers. In the advancing technology of today, chemical engineers need to brush up on this phase of their graphiology.

GERRY LESSELLS has been an engineer with U.S.I. since 1957. For six years before that he was a chemical and petrochemical development engineer at Mathieson and Olin Mathieson Chemical. He has an S.B. in ChE from MIT and is a licensed PE in Ohio.

Log—1/T Graph Paper

Chemical engineers very frequently need to plot the logarithm of a property against reciprocal absolute temperature. This special graph paper—shown in Fig. 1—has been developed for such plots.

Besides its best-known use in plotting vapor-pressure data for liquids according to the integrated Clausius-Clapeyron equation (*Chem. Eng.*, July 28, 1958, p. 110), the paper will give a straight-line plot for the theoretical equations below. The dependent variable (the one in the ln term) is plotted against temperature. Note how easy it is to use deg. C. (or F.) directly rather than 1/deg. K. (or 1/deg. R.).

• Vapor pressure of a solid at constant heat of sublimation:

$$\ln(P_1/P_2) = \triangle H_s(T_1 - T_2)/R\,T_1T_2 \quad (1)$$

Nomenclature

D	Diffusivity
ΔE_a	Reaction activation energy
ΔE_D	Diffusion energy
ΔE_V	Viscous flow energy
ΔH_f	Heat of fusion
ΔH_r	Heat of reaction
ΔH_s	Heat of sublimation
k	Reaction rate constant
K	Thermodynamic equilibrium constant
P	Pressure
R	Gas constant
S	Sales volume
t	Time
T	Absolute temperature
x	Mole fraction
μ	Viscosity

• Mole fraction of one component in a binary mixture exhibiting a eutectic with a constant heat of fusion:

$$\ln(x_1/x_2) = \triangle H_f(T_1 - T_2)/R\,T_1T_2 \quad (2)$$

• Thermodynamic equilibrium constant for a reaction at constant heat of reaction:

$$\ln(K_1/K_2) = \triangle H_r(T_1 - T_2)/RT_1T_2 \quad (3)$$

• Reaction rate constant at constant activation energy:

$$\ln(k_1/k_2) = \triangle E_a(T_1 - T_2)/R\,T_1T_2 \quad (4)$$

• Diffusion at constant activation energy for diffusion:

$$\ln(D_1/D_2) = \triangle E_D(T_1 - T_2)/R\,T_1T_2 \quad (5)$$

• Viscosity at constant activation energy for viscous flow:

$$\ln(\mu_2/\mu_1) = \triangle E_v(T_1 - T_2)/R\,T_1T_2 \quad (6)$$

In addition to the assumption of constant heat or energy associated with the changes above, there are other conditions—such as the ideal gas law holding—which must be true to obtain straight-line plots. The reader is referred to a physical chemistry text for complete statements of these conditions. But a chemical engineer usually plots this type of data and hopes for a straight line on log—reciprocal–temperature graph paper.

Straight lines are sometimes obtained on this paper purely by chance. For example, a plot of the weight percent solubility of boric acid in water vs. temperature yields a straight line on this paper. This is only a fortunate accident since there is no theoretical solubility relationship involving weight fraction of a component.

Many systems do give straight lines by this method however and this fact should be used to advantage. Also some solubility data may plot as straight lines on rectilinear, semi-log, or log—reciprocal–temperature graph papers using mole fractions. Unfortunately there is no general rule that predicts which plot will be the best.

Construct New Scale on Abscissa

e.g., Cox Chart of Vapor Pressure for Hydrocarbons

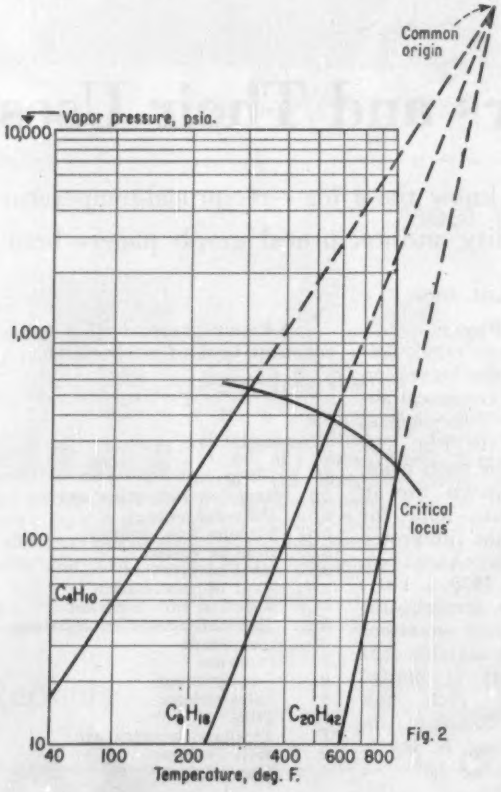


Fig. 2

Try These Vapor Pressure Plots in Some Cases

For the few materials where a straight-line plot is not obtained for vapor-pressure data on log—reciprocal–temperature graph paper, special methods are available. These technics plot the log of vapor pressure against a temperature scale derived from the vapor pressure of a reference substance—usually water. Cox, Duhring, Othmer and others have used this principle extensively. Perry's Handbook[5] gives examples and detailed explanations of these plots.

Fig. 2, an abbreviated Cox chart,[6] illustrates one of the special methods. Three members of a chemical family—the normal paraffins—give straight vapor-pressure lines when plotted against a temperature scale which is proportional to the vapor pressure of water, the reference material.

The lines originate at a common origin (of no theoretical significance) which permits the complete vapor-pressure curve of any member of the family to be plotted from only one known data point.

If the lines are curved for a chemical family, they often can be straightened by choosing as a reference substance a member of the same or a similar family.

Although this plot is tremendously useful, the construction of the special abscissa scale requires extra effort. To repeat, the special use of such plots is to predict the vapor pressure curve of a chemical when, say, only its normal boiling point is known. Of course the material must belong to a family in which there are some known vapor pressure curves.

Triangular Graph Paper for Ternary Systems

Fig. 3 shows the simplest application of triangular graph paper—the phase relationship for a three-component liquid system at a given temperature. A single line (the boundary line for complete miscibility) separates the phase regions. The amounts of components *A*, *B* and *C* are read from the coordinates at any point within the triangle.

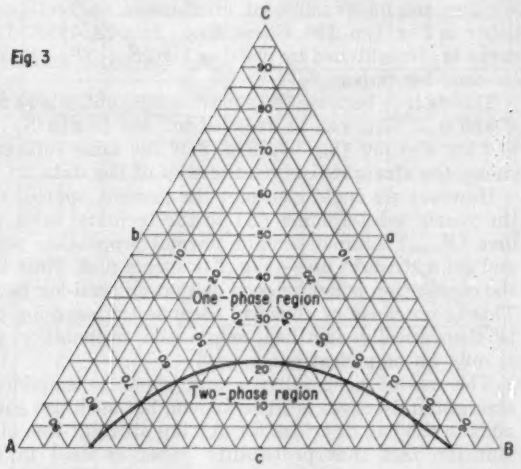
Fig. 4 illustrates the versatility of the triangular diagram in a more complicated system by showing the phase relationships among the three isomeric trichlorobenzenes as a function of temperature.

We can visualize this plot as the top-view of a three-dimensional surface where the temperature lines are contour lines around a triangular-shaped pit. The deepest point of this pit is the ternary eutectic below which no liquid exists, and the contour lines divide

Paper With Triangular Grids Does the Best Job of Plotting Ternary Mixtures

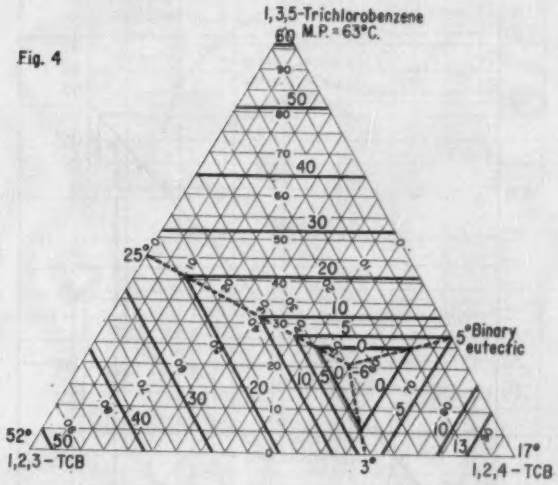
e.g., A 3-component mixture of 45 parts A, 35 parts B, 20 parts C gives a point on miscibility curve.

Fig. 3



e.g. Melting-point contours locate ternary eutectic at 24.5-55-20.5.

Fig. 4



the solid-liquid from the liquid region. This diagram was calculated from the second equation shown in the log—reciprocal–temperature section, modified to a ternary mixture.

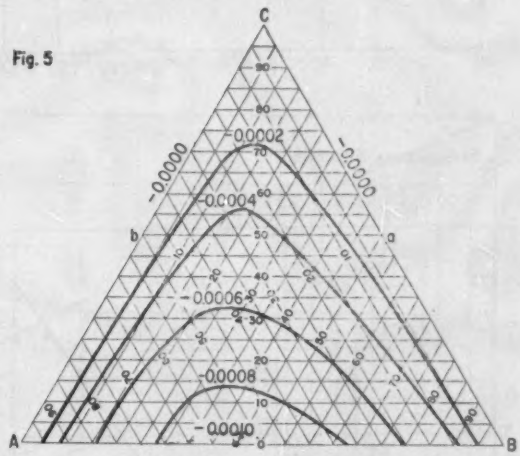
Another useful application of the triangular diagram is to plot correction factors or deviations of a system from ideality. Nonpolar liquids often show near-ideality with respect to refractive index as a molar function. In this case the following relationship holds: $x_A(n_A - n) + x_B(n_B - n) + x_C(n_C - n) = 0$, where x_A, x_B and x_C are mole fractions of the components; n_A, n_B and n_C are refractive indexes of the components; and n is the refractive index of the ternary mixture.

Near-ideality may be overcome by determining the non-ideality from measurements of the indexes of several mixtures. The difference between the observed index and the index calculated by assuming ideality is plotted. A plot such as Fig. 5 is the result of plotting the deviations on triangular graph paper and constructing lines of constant deviation by the method of contour traverses.

In this example mixtures of A and C and of B and C are ideal with respect to refractive index, i.e., the measured values show no deviation from the calculated. Mixtures of A and B deviate from ideality. This method of plotting a deviation instead of an actual value permits greater accuracy in reading data from the graph.

e.g., Deviation of refractive index from ideality would be —0.0002 for a 10-60-30 mixture.

Fig. 5



Probability Scale Graph Paper

Normal probability graph paper is excellent for determining whether or not data come from a normal universe. Once this point is established the plot can be used to find the average value $(\overline{X})$ of the sample averages $(\overline{X})$, the standard deviation (σ) and the 95% confidence interval.

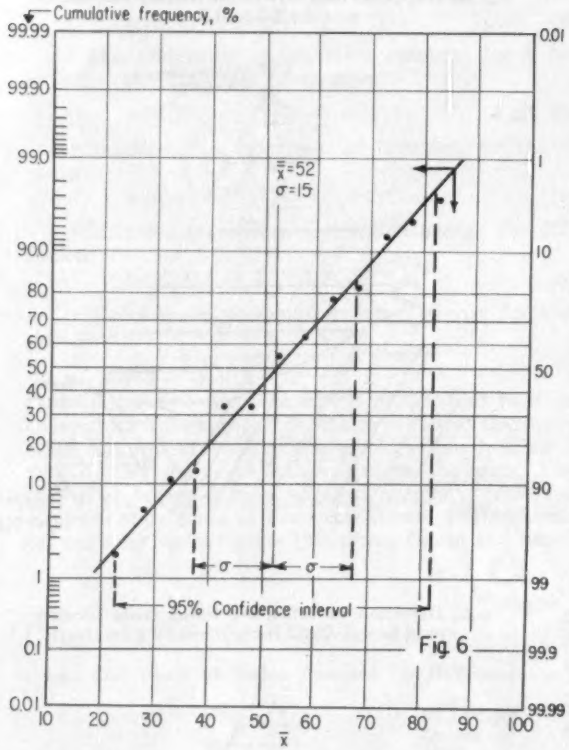
Fig. 6 is a plot of cumulative frequency for 13 samples of 5 each. The $(\overline{X})$ values are coded in cells of $\Delta(\overline{X}) = 5$, starting with the cell 20-25, and ending with 80-85. The straight-line correlation "proves" (only gives a strong indication, really) that the samples come from a normal universe.

We may now read all our statistical data from the plot, instead of computing them—a great savings of time. Since the median of a normal universe is also its arithmetic mean, we read the mean by taking the $(\overline{X})$ value at 50% cumulative probability. In our example this average of the averages is 52.

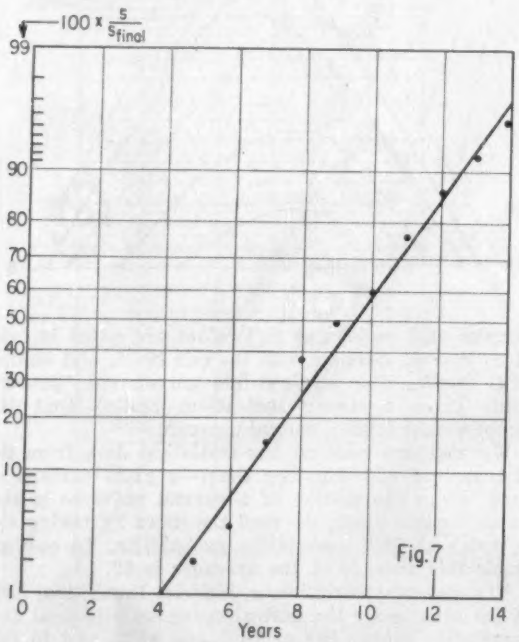
The standard deviation, σ, includes the central 68% of the area under the normal curve, so σ is read at a cumulative probability of 16% and 84%, and in this

Probability Scale Graph Paper

. . . Gives Statistical Data



. . . Straightens S-Curves



case equals 15. The 95% confidence interval is laid off between cumulative probabilities of 2.5% and 97.5%, and in this case the interval lies between 22 and 82.

Probability paper may also be used to straighten empirical S-curves because the cumulative frequency plot on rectilinear coordinates is an S-curve (ogive) itself. We can see an example of an S-curve on rectilinear paper in Fig. 1, p. 109, *Chem. Eng.*, July 28, 1958. This curve is straightened by plotting log (S_{final}/S) vs. time on semi-log paper.

This is true because the equation $S = ab^z$, where $z = c^t$ and $a = S_{final}$ can be reduced to: log [log(a/S)] = $-t \log c - \log (\log b)$. Fig. 2 of the same reference shows the straight-line relationship of the data.

However we could also plot the percent approach of the yearly sales volume (S) to the terminal sales volume (S_{final}) against time on normal probability paper and get a straight line—Fig. 7 is such a plot. Note that the correlation is not as good as that on semi-log paper. This is no cause of concern, because the semi-log plot is theoretically justified, while the probability plot is only an empirical one.

The use of probability graph paper to empirically straighten S-curves is little-known, but such use surely adds to the bag of tricks for getting straight-line plots. But the fact that probability paper is used in this service must not lead us to conclude that the data are related to a normal distribution.

Reciprocal Ruling or Hyperbolic Graph Paper

Reciprocal paper is practically unknown to chemical engineers. Yet in some repects it is probably the most versatile of all graph papers. Basically the equation $y = a/x$ is plotted on it as a straight line, since one coordinate scale of the paper is marked off in proportion to a reciprocal scale.

Its two main advantages are that infinity (∞) can be plotted as a discrete point and that the reciprocal scale can be multiplied by a constant to increase or decrease the scale while ∞ is kept as a point on the graph. The paper permits us to plot almost any second-degree curve with a small radius of curvature as a nearly straight line.

An example of this paper for plotting a reciprocal relationship is shown in Fig. 8. In this case steam diluent is fed to a reactor operated at various temperature levels. We want to feed steam at a rate that will enable it to absorb constantly 100,000 gm.-cal./hr. We will do this by vaporizing water at the required rate with electrical heating and feeding the steam at 100 C. and 100% quality to the reactor.

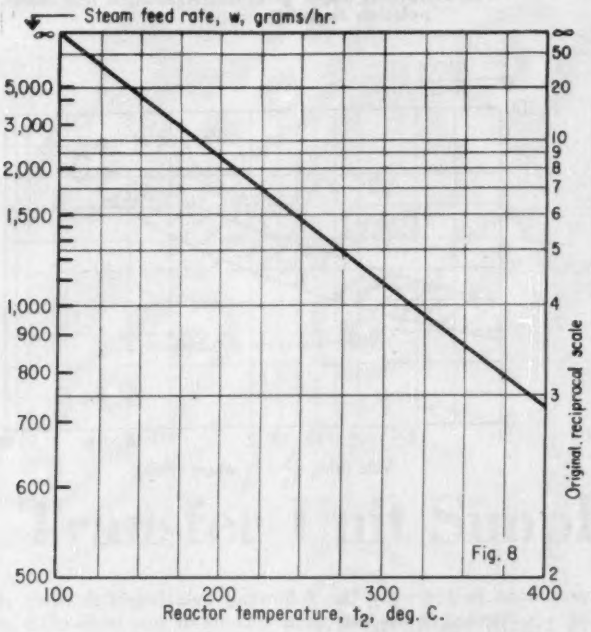
The heat balance equation is: 100,000 = $(w/18)$ (M_c) $(t_2 - 100)$, where w is gm./hr. steam required; M_c is the molal average heat capacity of steam = 8.2 cal./(gm.-mole, deg. C.); and t_2 is the reactor temperature, C.

This equation is of the form $y = a/x$, so we calculate w for two values of t_2 and plot w against t_2 on reciprocal ruling graph paper to get a straight line. Note in Fig. 8 that the steam required at $t_2 = 100$ C. is ∞, a point actually plotted on the ordinate.

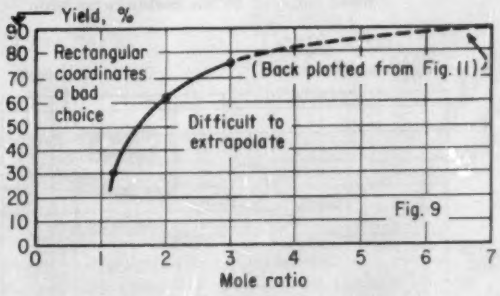
Besides straight-line plots obtained on reciprocal graph paper for exact reciprocal relationships, nearly straight lines can be gotten for many curves which are asymptotic to a constant value. Yield data lend themselves well to this treatment.

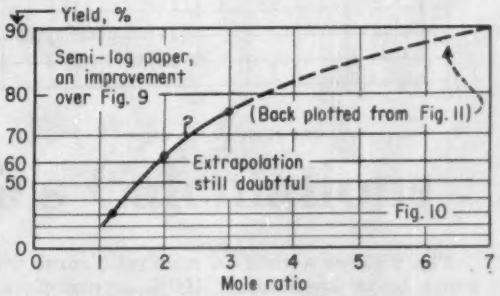
Reciprocal Ruling (Hyperbolic) Paper Plots Infinity & Second-Degree Equations

Equation of the Type xy = a Gives Straight Line

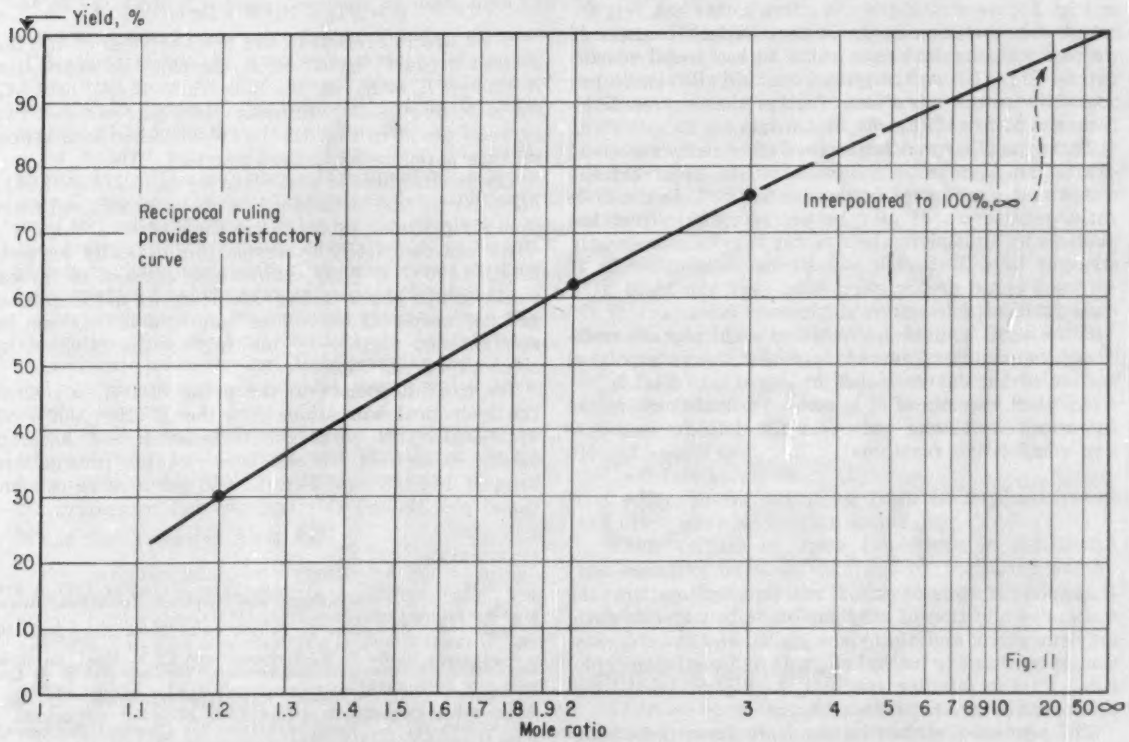


Three Data Points Hard to Extrapolate on Ordinary Papers



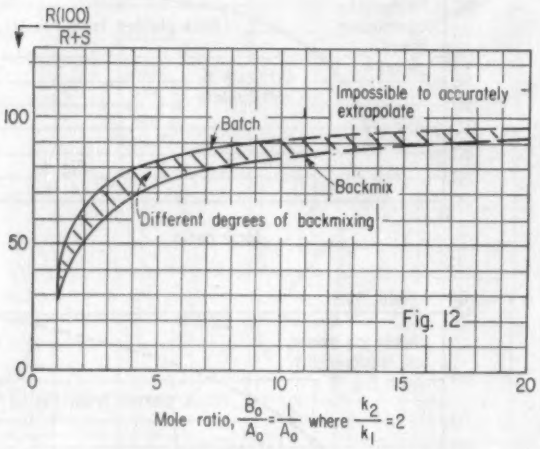


Reciprocal Graph Paper Gives Easy Extension of Yield Data Over Whole Range to 100%. ∞



Plot Equations That Approach Infinity as Limiting Value on Reciprocal Paper

e.g., Six-place log table not accurate enough above mole ratio = 10 on rectangular plot.



But, reciprocal paper gives nearly straight line interpolation to 100%, ∞.

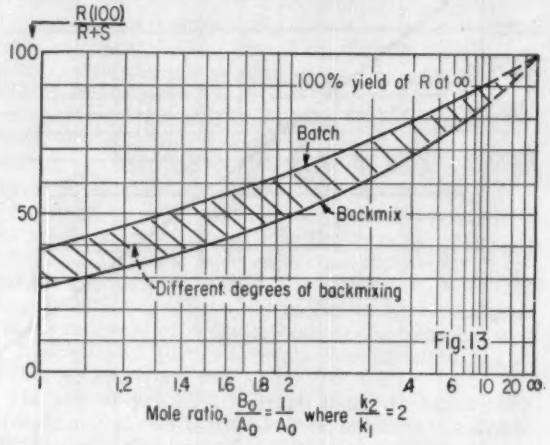


Fig. 9 shows a yield vs. mole ratio curve which appears to be approaching 100% asymptotically. The curve unfortunately has a very short radius of curvature, so it is not only difficult to draw the "best" curve through the three data points, but it is practically impossible to extrapolate the curve beyond these points.

By plotting the same data on inverted semi-log paper in Fig. 10, we straighten the curve somewhat, but accurate extrapolation again is impossible. However if we plot yield against mole ratio on reciprocal coordinates—Fig. 11—we straighten the line. But more importantly we can interpolate (rather than extrapolate) from the point (100%, ∞) to our data.

This type plot can often be used since many reactions exhibit an asymptotic approach of the yield (of the component not present in excess) to 100% as the mole ratio goes to ∞. It may be necessary to adjust the abscissa by multiplying by a factor to get a more nearly straight line. But such adjustment is worthwhile if we need some preliminary data—say the yield at a mole ratio of 6 in our example case.

If we wish a more conventional yield plot on rectilinear coordinates, we can back-plot the interpolated section of the curve, dashed in Fig. 11, to Fig. 9.

Another example of this method's usefulness is the important industrial case of yield data for consecutive competitive reactions:

$$A + B \xrightarrow{k_1} R$$

$$A + R \xrightarrow{k_2} S$$

Examples of this type of reaction system are the successive addition of ethylene oxide to water to form ethylene glycol and diethylene glycol, and the chlorination of methane to methyl chloride and methylene chloride. Further similar reactions to higher substituted products are ignored for simplicity.

The product distribution resulting from these reactions is given by the following relationships when A is reacted completely, and a basis of one mole of B at time zero is taken:

For the batch or plug-flow reactor:

$$R = (B^{k_2/k_1} - B)/[1 - (k_2/k_1)]$$

For the stirred tank or 100% backmix reactor:

$$R = B\,(1 - B)/[B + (k_2/k_1)\,(1 - B)]$$

If we are interested in the percent yield of R (the desired product) based on B, we plot the expression $R\ (100)/(R + S)$ vs. the mole ratio B_o/A_o, or $1/A_o$. On a conventional rectilinear yield plot we get two curved lines as in Fig. 12, the crosshatched area representing partially backmixed reactors.

The trouble here is that when we calculate $R\ (100)/(R + S)$ we find at mole ratios above 10 we need more than six-place log tables to get the desired accuracy.

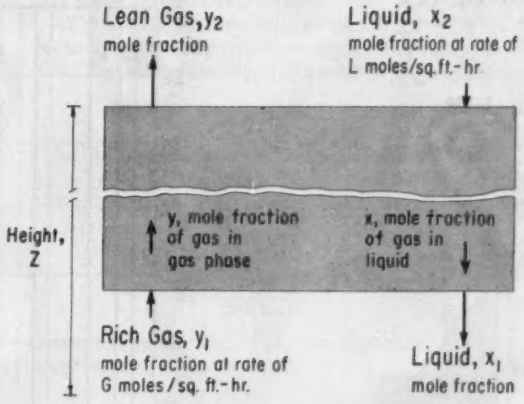
We can completely overcome this difficulty by plotting $R\ (100)/(R + S)$ against mole ratio on reciprocal ruling graph paper in Fig. 13. Here we get lines that are not nearly as curved as before, and they can be straightened further by multiplying the abscissa by some expanding factor.

We can interpolate to the point (100%, ∞) since the theoretical expressions show that $R\ (100)/(R + S)$ approaches this point for both batch and backmix cases. As before, we can back-plot the interpolated lines of Fig. 13 onto Fig. 12 and get a more conventional plot though this is really not necessary.

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$$N_{OG} \text{ transfer units} = \int_{y_2}^{y_1} \frac{dy}{(y-y^*)}$$



Transfer Unit Simplifies Calculations

For continuous direct contacting between fluid streams, transfer unit method gives results less sensitive to changes in flow rate.

JAMES O. OSBURN, State University of Iowa, Iowa City, Ia.

ANYONE who makes mass transfer design calculations needs to know about transfer units. More and more we find mass transfer rate data reported in terms of the height of a transfer unit instead of as mass transfer coefficients.

As pointed out in *Chem. Eng.*, July 14, 1958, p. 147, use of the transfer unit concept gives some advantages over the use of mass transfer coefficients or of theoretical stages. In this article, we show how the transfer unit greatly simplifies calculations. It is especially useful when we have direct contact between two fluid streams as in packed columns.

The fundamental idea has wide application in gas absorption, extraction, distillation, adsorption, humidification and drying. Heat transfer and chemical reaction kinetics have also been treated in a similar manner.

We shall use gas absorption for the examples in this article. The equations and techniques shown here apply equally well to other operations.

What the Transfer Unit Is

For our discussion, let's consider a gas absorber for which the concentrations and flow rates are shown in the above illustration. In passing through a height Z in this absorber, the concentration in the gas phase is reduced from y_1 *to* y_2. The composition of the liquid which flows countercurrent to the gas increases from x_2 to x_1. We define y as the mole fraction of one component at some point in the absorber. At the same point, x is the mole fraction in the liquid and y^* is the gas phase composition in equilibrium with liquid composition x.

The number of transfer units is a measure of the difficulty of the separation. The difficulty of a separation varies directly with the composition change, and inversely with the driving force.

Basically, we define the number of transfer units N by the equation:

$$N_{OG} = \int_{y_2}^{y_1} \frac{dy}{(y - y^*)} \qquad (1)$$

In this equation the term dy represents the composition change and $(y - y^*)$ the driving force. This ratio is integrated over the range of composition of y from the outlet to the inlet. (Integration is taken in this order because y_1 is greater than y_2.)

When one of the following conditions is met, Eq. (1) applies.

- Dilute solutions.
- Equi-molar diffusion from each phase into the other such as in distillation.

When neither of these conditions is satisfied, the equation must be modified by including some correction factors. We'll list the modified equations later.

Completing the Design

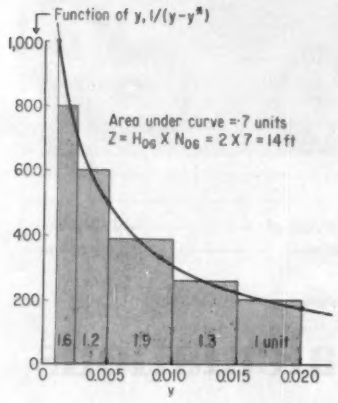
When we have calculated the number of transfer units, we calculate the height of the absorber Z by

Find Number of Transfer Units by Graphical Integration or Colburn's Chart

Use graphical integration to solve Eq. (1).

$$N_{OG} = \int_{y_2}^{y_1} \frac{dy}{(y - y^*)} \qquad (1)$$

Fig. 1

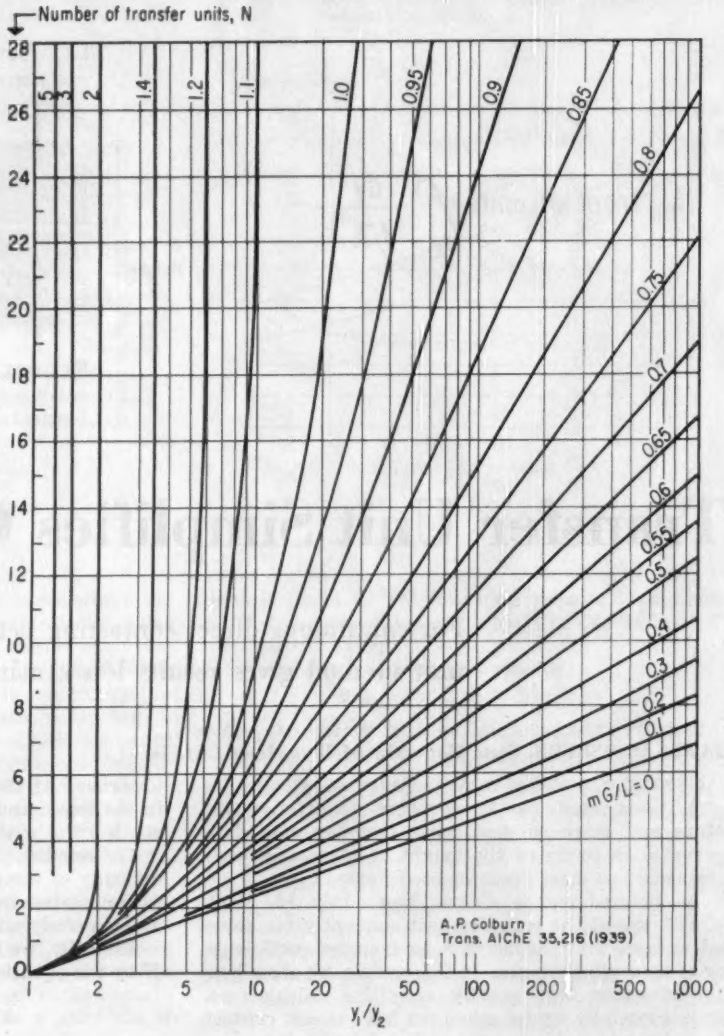


y	x	y^*	$y-y^*$	$\frac{1}{y-y^*}$
0.001	0	0	0.001	1000
0.005	0.002	0.003	0.002	500
0.009	0.004	0.006	0.003	333
0.020	0.0095	0.0142	0.00575	174

Colburn's chart solves Eq. (3) and permits rapid evaluation of transfer units.

Fig. 2

$$N_{OG} = \frac{\ln\left[\left(1-\frac{mG}{L}\right)\left(\frac{y_1}{y_2}\right)+\frac{mG}{L}\right]}{\left(1-\frac{mG}{L}\right)} \qquad (3)$$



multiplying the height of a transfer unit H by an equipment factor. Thus, we may write

$$Z = H_{OG}N_{OG} \qquad (2)$$

Here we use a commonly accepted convention for the subscripts. The subscript OG stand for "over-all, based on the gas phase compositions."

For over-all transfer units, just as for over-all mass transfer coefficients, the driving force is based on equilibrium values. Thus we have the term $(y—y^*)$ where y^* is the equilibrium composition.

The subscript O is omitted when transfer units are based on a single film. Thus N_G stands for the number of transfer units based on the gas film alone. After we show how to use transfer units, we'll cover this subject in more detail.

If we have more than two components, we may base our calculations on either component. This choice is often available in extraction calculations. Generally, we will choose the component which varies the most. Of course, we should always state the basis clearly, as the height of a transfer unit is different for different components.

Why Transfer Unit Is Better

There is a sound basis for the popularity of the transfer unit method. There are three major advantages over other methods:

- Transfer unit equations are based on continuous direct contact between phases, where the equilibrium stage concept does not apply.
- Equipment efficiency which is the height of a transfer unit has the dimensions of length and is usually given in feet. This avoids the confusion of

units which result from the use of mass transfer coefficients such as K_Ga.

• Height of a transfer unit is less sensitive to changes in flow rate. For example, the gas film k_Ga varies with the 0.8 power of the gas flow rate. Often this means we can't assume k_Ga to be constant when we have lots of absorption. On the other hand, H varies with the 0.2 power of the gas rate and we can use a constant average value.

Using the Transfer Unit

To calculate the number of transfer units, we can always use graphical integration to solve the integral in Eq. (1). Sometimes we can make some assumptions which permit us to integrate the expression in Eq. (1) by calculus. We will illustrate these methods with a gas absorption problem.

Problem—Find the number of transfer units and the height of an absorber when:

G = 100 moles of gas/sq. ft.-hr.
L = 200 moles of liquid/sq. ft.-hr.
y_1 = 0.020
y_2 = 0.001
x_2 = 0
H_{OG} = 2 ft.
Equilibrium relationship: $y^* = 1.5x$

Because the solutions are dilute, we assume G and L to be essentially constant. For example, only about 2% of the gas is absorbed; so the gas rate changes only this much. We may also use Eq. (1) since solutions are dilute.

A material balance gives values of x corresponding to some assumed values of y. $G(y - 0.001) = Lx$. From x, we calculate the equilibrium values of y^* by means of the equilibrium relationship, $y = 1.5x$. We then calculate $1/(y\text{-}y^*)$ and plot against y as shown in Fig. 1. The area of the desired integral from 0.001 to 0.020 is 7 units. Therefore, $N_{OG} = 7$ and the height $Z = H_{OG}N_{OG} = (2.0)\ (7) = 14$ ft.

Use Simplified Methods

Colburn [*Trans. AIChE*, 35, 211 (1939)] has shown how to integrate the expression in Eq. (1) when the equilibrium relationship is a straight line, $y^* = mx$. He obtained this equation:

$$N_{OG} = \frac{\ln\left[\left(1 - \frac{mG}{L}\right)\left(\frac{y_1}{y_2}\right) + \frac{mG}{L}\right]}{\left(1 - \frac{mG}{L}\right)} \qquad (3)$$

This equation is not particularly convenient to use, but it has been made into a chart which is very convenient. This chart is shown in Fig. 2. Let's use it to solve the previous example.

First, calculate $y_1/y_2 = 0.020/0.001 = 20$
Next, calculate mG/L
Here, $m = y^*/x = 1.5$
Hence, $mG/L = (1.5)\ (1)/2 = 0.75$

For $y_1/y_2 = 20$ and $m/GL = 0.75$, we read the number of transfer units N from Fig. 2. Since transfer units $N = 7$, the height $Z = 7 \times 2 = 14$ ft. as before.

When as in the example both operating line and equilibrium curve are straight lines, we may calculate the number of transfer units from the logarithmic average $(y - y^*)$. This procedure is very convenient even where the lines aren't exactly straight, but some error is introduced.

If we take an average value of $(y - y^*)$, this term may be removed from under the integral sign. We then integrate Eq. (1) to give:

$$N_{OG} = \frac{y_1 - y_2}{(y - y^*)_{l.m.}} \qquad (4)$$

In the example, we have calculated values of $(y - y^*)$. At the top, $(y - y^*) = 0.001$ and at the bottom, $(y - y^*) = 0.00575$. Hence, log mean $(y - y^*)$ equals

$$\frac{0.00575 - 0.001}{\ln_e \frac{0.00575}{0.001}} = 0.00275$$

Substituting in Eq. (4), we find the number of transfer units $N_{OG} = 7$.

How to Handle Higher Concentrations

We can apply Eq. (1) only to dilute solutions, unless there is diffusion of material equally in both directions such as in distillation. For higher concentrations some modifications are needed. The result is the following equation which has more general application:

$$N_{OG} = \int_{y_2}^{y_1} \frac{(1 - y)_M\, dy}{(1 - y)\,(y - y^*)} \qquad (5)$$

The term $(1 - y)_M$ is the log mean of $(1 - y)$ and $(1 - y^*)$.

We note that Eq. (5) differs from Eq. (1) by the term $(1 - y)_M/(1 - y)$. When y is low, this term approaches 1. For example, under the conditions of the problem solved previously, we can calculate the magnitude of this correction.

y	y^*	$1 - y$	$1 - y^*$	$(1 - y)_M$	$\frac{(1 - y)_M}{1 - y}$
0.020	0.0095	0.980	0.9905	0.9852	1.005
0.001	0	0.999	1.000	0.995	1.000

We can approximate Eq. (5) by another equation which is more convenient to use (R. E. Treybal, "Mass Transfer Operations," p. 230, McGraw-Hill Book Co., 1955).

$$N_{OG} = \int_{y_2}^{y_1} \frac{dy}{y - y^*} + \frac{1}{2} \ln \frac{1 - y_2}{1 - y_1} \qquad (6)$$

Another example shows how these correction terms become more important at higher concentrations.

Problem—Find the number of transfer units for the following conditions:

G_o = 100 moles entering/sq. ft.-hr.
L_o = 200 moles leaving/sq. ft.-hr.
y_1 = 0.20
y_2 = 0.01
Equilibrium: $y^* = 1.5x$

This time we must calculate the operating line (x vs. y) in a different manner, since the flow rates are far from constant. The material balance is based on the inert gas and liquid and is given by

$$G\,(1 - 0.20)\left(\frac{y}{1 - y} - \frac{0.01}{0.99}\right) = L\left(\frac{x}{1 - x}\right) \qquad (7)$$

Find N_{OG} for Higher Concentrations

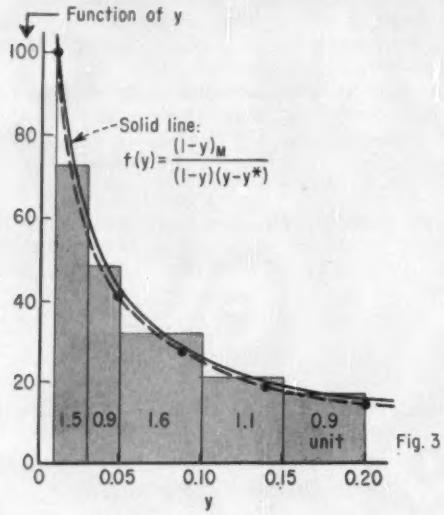


Fig. 3

y	x	y^*	$1-y$	$1-y^*$	$(1-y)_M$	$\frac{1}{y-y^*}$	$\frac{(1-y)_M}{(1-y)(y-y^*)}$
0.01	0	0	0.99	1.00	0.995	100	100.5
0.05	0.016	0.025	0.95	0.983	0.967	40	40.7
0.09	0.035	0.053	0.91	0.947	0.928	27.2	27.7
0.14	0.057	0.086	0.86	0.913	0.887	18.8	19.4
0.20	0.087	0.131	0.80	0.868	0.834	14.6	15.2

The calculation proceeds as before, except for the extra terms now included. In Fig. 3, we plot the function in the last column against y. We find $N_{OG} = 6.0$. Here N_{OG} is the area under the curve from $y = 0.01$ to $y = 0.20$.

We can use Eq. (6) instead, by plotting $1/(y - y^*)$ against y. Graphical integration as shown in Fig. 3 gives:

$$\int_{0.1}^{0.20} \frac{dy}{(y - y^*)} = 5.9$$

Substituting in Eq. (6) gives us the number of transfer units, $N_{OG} = 5.9 + 0.5\ln(0.99/0.80) = 6.0$.

We see that the correction term adds about 2% in this case. The effect is greater for a larger value of M.

Comparison With Transfer Coefficients

Much of the older data for packing performance give K_ya and not H. Of course, we can do a design using K_ya. However, it is a relatively simple matter to retain the advantages of the transfer unit method by converting the K_ya values to H.

The relation between the height of a transfer unit H and K_ya is

$$H_{OG} = \frac{G}{K_yaP\,(1 - y)_M} \qquad (8)$$

Here, P is total pressure.

For distillation, where 1 mole of the more volatile material leaves the liquid for each mole of the less volatile which enters, the term $(1 - y)_M$ is omitted.

$$H_{OG} = G/K_yaP \qquad (8a)$$

Note that the units in this equation are consistent.

$$\text{ft.} = \frac{\text{lb. moles/sq. ft.-hr.}}{\text{(lb. moles/cu. ft.-hr.-atm.) (atm.)}}$$

Controlling Film Basis of Transfer Unit

In *Chem. Eng.*, May 19, 1958, p. 169, we discussed the importance of fluid films as resistance to mass transfer. Depending on conditions, the resistance in one phase is usually higher than that in the other. We then say that the film with the higher resistance controls.

Transfer unit calculations are based on the controlling film which is the phase where the greatest resistance is found. In the earlier article, we assumed that the gas film controls. For other systems, the liquid film controls. We have, by analogy, similar equations for this case.

$$N_{OL} = \int_{x_2}^{x_1} \frac{(1 - x)_M\,dx}{(1 - x)\,(x^* - x)} \qquad (9)$$

$$N_{OL} = \int_{x_2}^{x_1} \frac{dx}{(x^* - x)} + \frac{1}{2}\ln\frac{1 - x_2}{1 - x_1} \qquad (10)$$

$$Z = N_{OL}\,H_{OL} \qquad (11)$$

$$H_{OL} = \frac{L}{K_{Le}\,D_M\,(1 - x)_M} \qquad (12)$$

D_M is the molar density, lb.moles/cu.ft.

In extraction, it often happens that neither film is completely predominate. Then the transfer units may be based on either phase. N_{os} is based on the raffinate. N_{os} is based on the extract.

Single Film Transfer Units

With transfer units, just as with mass transfer coefficients, we can base the rate on interfacial conditions rather than equilibrium conditions. If we call y_i the true concentration at the interface, we may define the gas film transfer unit N_G and the liquid film transfer unit N_L.

$$N_G = \int \frac{dy}{(y - y_i)} \qquad (13)$$

$$N_L = \int \frac{dx}{(x_i - x)} \qquad (14)$$

Corresponding to these, we have the height of a transfer unit H_G and H_L.

$$H_G = Z/N_G \qquad (15)$$

$$H_L = Z/N_L \qquad (16)$$

The usefulness of the last two equations is in correlating and interpreting rate data.

$$H_{OG} = H_G + mGH_L/L \qquad (17)$$

$$H_{OL} = H_L + LH_G/mG \qquad (18)$$

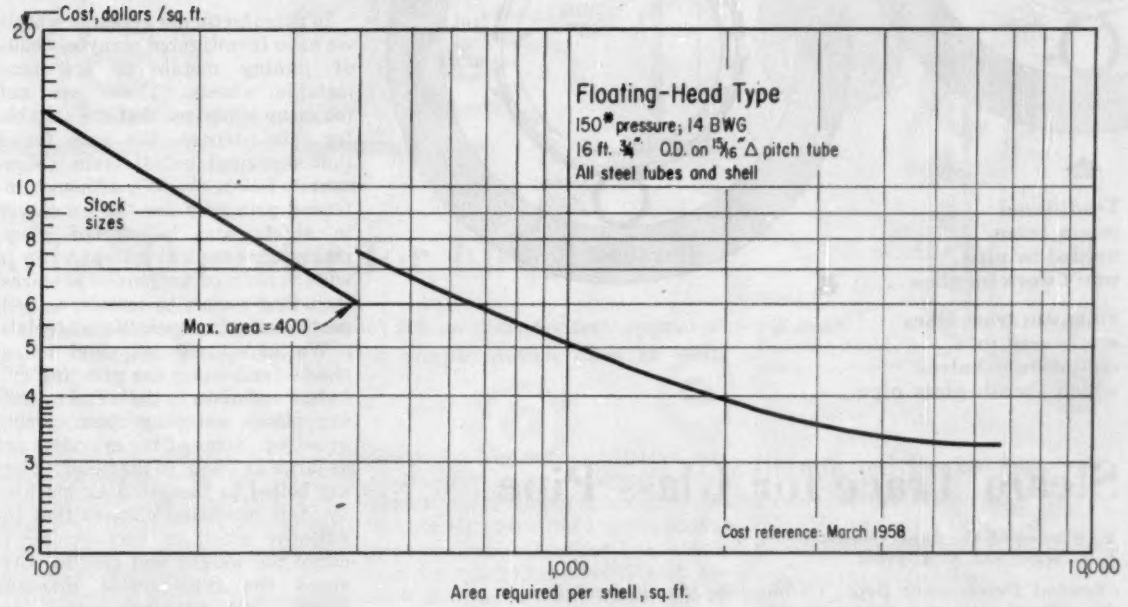
What's Next

There are some rather unusual aspects of mass transfer when one phase is a solid such as in adsorption and ion exchange. In our next article, we shall discuss mass transfer as it applies to these operations.

CE Cost File—III

Melvyn Sotnick,
United Engineers & Constructors, Inc., Philadelphia, Pa.

Cost of Heat Exchangers . . . Today



To Use: Multiply cost from the graph by the product of all the factors required to convert the standard exchanger to your own case.

Tube Diameter & Pitch Factors

¾" O.D.	1"	△	Pitch	1.0
¾" O.D.	1"	□	Pitch	1.08
1" O.D.	1¼"	△	Pitch	1.08
1" O.D.	1¼"	□	Pitch	1.12

Tube Material Factors

	400 Sq. Ft.	1,000 Sq. Ft.	4,000 Sq. Ft.
14 Bwg steel	1.0	1.0	1.0
16 Bwg aluminum 3S	1.1	1.1	1.0
Karbate	1.2	1.6	2.0
16 Bwg Admiralty and naval brass	1.4	1.4	1.5
Copper	1.4	1.4	1.6
70–30 Cupro-nickel	1.6	1.7	1.8
Ampco 8	1.6	1.8	2.0
16 Bwg Type 304 SS	1.8	2.1	3.2
16 Bwg Type 316 SS	2.0	2.4	2.5
16 Bwg Type 347 SS	2.0	2.4	2.5
Monel	2.0	2.2	2.5
Nickel	2.1	2.3	2.7

Shell Material Factors

18–8 Tubes, lined channels	3–4
18–8 Tubes, lined channels and clad shell	4–5
4–6 Chrome shell only	2.5–3.5
18–8 Shell only	4.5–5.0

Construction Factors

U-Tube removable	0.85
Fixed tube sheet	0.80
Straight tube kettle reboiler	1.35

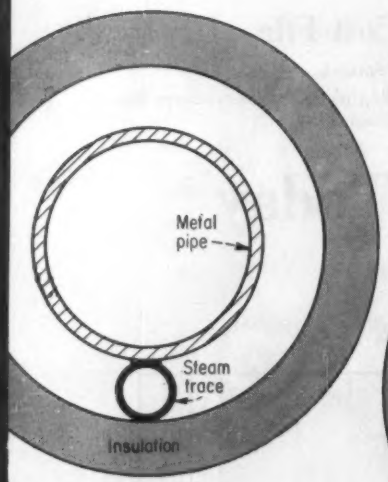
Pressure Factors

Psia.	400 Sq. Ft.	1,000 Sq. Ft.	4,000 Sq. Ft.
150	1.0	1.0	1.0
300	1.02	1.06	1.2
450	1.1	1.2	1.26
600	1.15	1.3	1.47

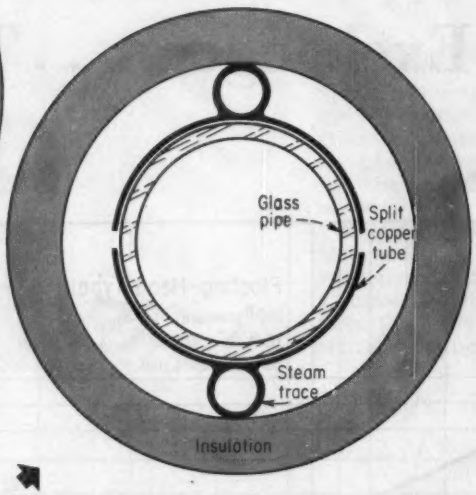
Tube Length Factors

8 ft	1.3
12 ft	1.1
16 ft	1.0
20 ft	0.95

Data based on articles by J. Happel, R. S. Aries, W. J. Borns, H. Bliss, and F. L. Rubin in *Chem. Eng.*, Oct. 1946; May 1947; May, July, Sept. and Oct. 1953; May 1957 and by D. Q. Kern in *Pet. Ref.*, Aug. 1956.



Traditional steam trace, welded to pipe, won't work on glass . . .



So steam trace lines are brazed to copper-tube halves which sheath glass pipe.

Steam Trace for Glass Pipe

★ **Winner of the June Contest by J. R. Scace and A. A. Fried**

Chemical Development Dept., Chemical & Metallurgical Div. General Electric Co., Pittsfield, Mass.

In our plant we have a glass piping system which must be kept hot to prevent the material flowing in it from solidifying. To follow the customary practice in steam tracing metal pipe would not be satisfactory, so we worked out a special method which is described here. The same method can be applied effectively with other nonmetallic pipe also which, like glass, has rather poor thermal conductivity.

In steam tracing a metal pipe (see lefthand sketch), the trace line can be run along the pipe and, to insure good heat transfer, is usually welded, brazed or clamped to it. The high thermal conductivity of the pipe will distribute the heat uniformly. But with glass and other nonmetals which are poor thermal conductors, steam tracing in the same way might get the pipe surface nearest the trace line hot enough—but the rest of the pipe would be too cool.

The new method is relatively easy to install, it provides uniform heat distribution without hot or cold spots, and it gives a measure of personal protection in case of breakage of the pipe.

The righthand sketch shows the new method. We obtained a thin-wall copper tube of inside diameter equal to the outside diameter of the glass. This we cut in half longitudinally so that the two halves could be placed around the glass to make a copper sheath. The steam lines were then brazed to the copper sheath so that the sheath transferred heat uniformly to the entire glass surface.

The method worked very well and eliminated an annoying problem. Also it provided protection against mechanical breakage of the glass. The same method should be equally suited to other nonmetallic pipe such as stoneware, porcelain and plastics.

"Glass-Sandwich" Resin Can Join Metals

Stasys Maziliauskas

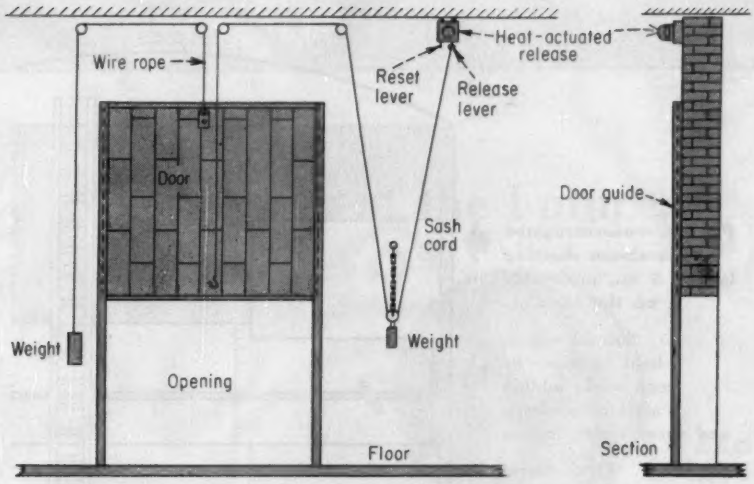
Technical Director, The Wickman Corp., Oak Park 37, Mich.

In manufacturing grinding wheels we have investigated many methods of joining metals to the nonmetallic wheels. There are not too many adhesives that are suitable for this purpose. We have found that polyvinyl butral resin (Monsanto's Saffex sheets), although intended primarily for the interlayer in safety and bulletproof glass, makes an excellent adhesive for a wide variety of nonporous surfaces, including metals to metals, as well as to many nonmetallic materials.

We have used polyvinyl butral sheets for joining the grinding cylinders and disks to the metal mounting plates, carrying them during grinding. Some of the cylinders are as large as 14 in. in diameter. They are bolted to the grinding machine by their mounting plate so that the adhesive must be very strong to carry the weight and also to withstand the considerable grinding force. That polyvinyl butral does this job satisfactorily attests to its extreme toughness and resiliency, as well as its water and thermal resistance.

The metal to be joined must be sandblasted or otherwise made perfectly clean, dry and grease-free. If one of the materials to be joined is porous or of coarse surface, it is well to use two or even three layers of the resin sheet, cut to shape. For better contact and to improve cross-linking and other bond characteristics, both surfaces to be joined should be coated with a solution of thermosetting resins—usually phenolic—and allowed to dry completely. A typical resin solution suitable for this purpose is Resin No. 752, made by Palmer Products, Inc., Worcester, Pa.

To develop the bond, pressure must be applied with weights or otherwise over the entire bond area. A short cure at 325 F. in an oven, or with some local heating method, completes the cure.



Robot Operator for Fire Door

You can spend a lot of money for an underwriters'-approved self-closing fire door. This simple design does as well.

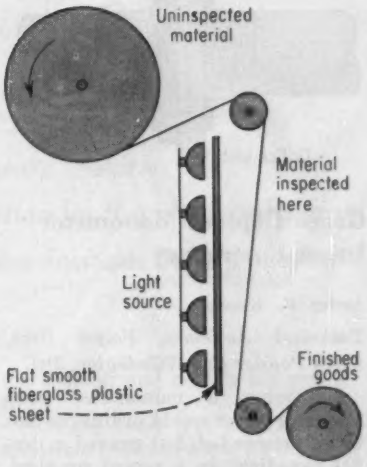
Paul C. Ziemke
Engineer, Clinton, Tenn.

Plants and laboratories which are being converted from the routine handling of acids and alkalis, to work with volatile materials, can present quite a problem to the fire prevention engineer.

The elevator shaft, for example, must now be provided with a self-closing fire door. Using underwriters'-approved equipment can mean the need for an expensive motorized unit to handle the heavy door.

Many such installations can operate within the rules by installing a fire door which is normally open and closes only in an emergency. The sketch above shows a simple self-closing rig operating a conventional door of double-sheathed $\frac{7}{8}$-in. stock, laid diagonally for rigidity and covered both sides with 22-ga. tin or galvanized stock.

The door is partially counterbalanced by a weight at the left supported by $\frac{1}{4}$-in. wire rope running over 5-in. pulleys. Sash cord reeved over similar pulleys and attached to a heat-release device provides the rest of the counterbalancing. The second counterbalance weight, at the right, is snubbed by a chain to avoid dropping when released. The release is of the conventional rate-of-temperature-rise type, placed near the ceiling where the heat from a fire would be most intense.



Illuminated Device Inspects Translucent Materials

P. N. Cheremisinoff and P. R. Durkin
Alsynite Co. of America
Paterson, N. J.

Sketched above is an illuminated inspection setup which is handy in the production of materials requiring visual inspection, for example, textiles or sheet or roll plastic materials.

We developed this inspection apparatus for quality control in a nearby textile mill. Its novel feature, which has proven highly successful, consists in placing a sheet of clear or white, smooth, flat fiberglass-reinforced plastic between the light source and the material to be inspected. This sheet acts as a diffuser and gives a uniform illumination of the material being inspected.

This arrangement has several advantages, among them: (1) transmits diffused light, giving an even, glare-free source of light without heavy or weak light spots; (2) by reason of the shatterproof nature of the plastic material, eliminates danger to the material itself and to the light source as a result of careless handling.

NEXT ISSUE: Cut Noise of Live Steam Heating
By Javier F. Kuong, Winner of the Mid-Summer Contest

★ How Readers Can Win

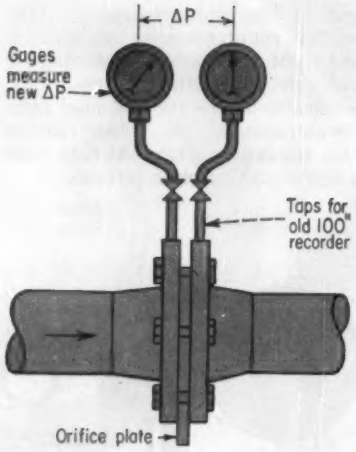
$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 min.)

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.



Gages Replace Manometer In an Emergency

Javier F. Kuong

Technical Assistant, Polyol Dept. Atlas Powder Co., Wilmington, Del.

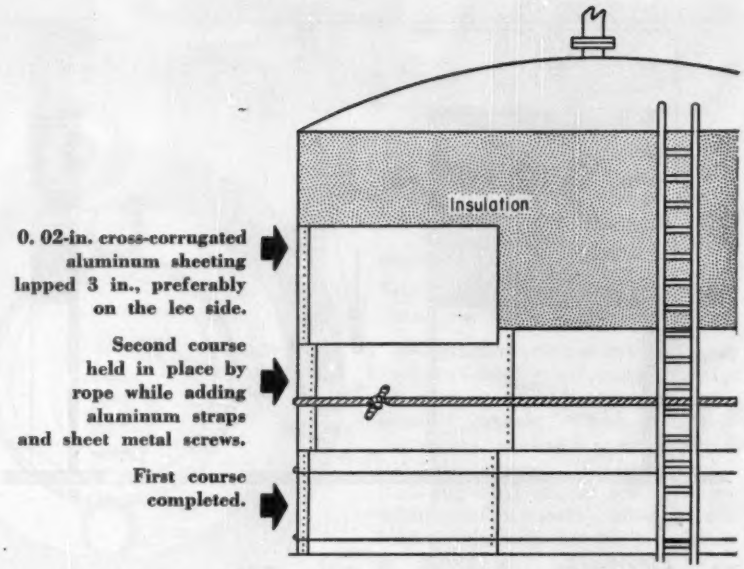
Replacing a manometer with pressure gages would ordinarily not be recommended, but proved a useful expedient in a recent problem.

We had need to make a quick flow rate determination for cost estimation purposes. We hooked a flow recorder of 100-in. w.g. differential—the only one available—onto the existing orifice taps. As soon as the gas was allowed to flow, the recorder pen immediately traveled to its maximum, indicating that the meter range was insufficient for the available orifice diameter and the existing flow rate.

Since we had to get the necessary flow data without further delay, we decided to forego the refinement of a recorder of proper differential and do the job with pressure gages.

Our storeroom was able to provide two pressure gages with a capacity slightly greater than the maximum line pressure in the pipe. These were hooked up side by side on the two orifice pressure taps. Now, by reading the two pressures, we were able to take their difference as a measure of the differential pressure of flow through the orifice.

This method was crude and undoubtedly sacrificed accuracy as compared with a good manometer. However, it was sufficiently good, considering the degree of precision required by most cost estimates—and it had the great advantage of saving time.



Jacketing Insulated Equipment

Weatherproofing insulation on tanks and pipes is facilitated by using cross-corrugated, felt-backed aluminum sheets.

J. K. Paul
Engineer, Oak Ridge, Tenn.

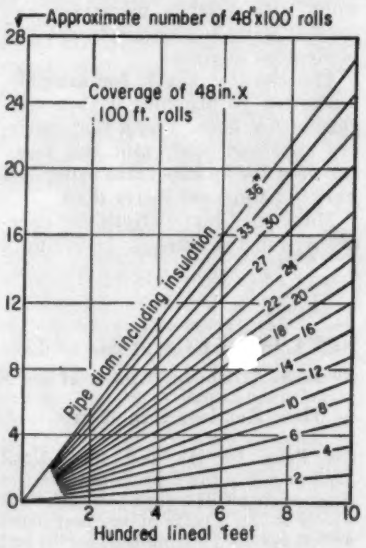
Corrugated-finish aluminum jacketing—preferably about 0.020 in. in thickness—is an excellent weatherproofing for insulated tanks and piping. The chart at the right gives a quick check of the quantity of jacketing required for piping, making allowance for the normal longitudinal and circumferential laps.

To use the chart, find the intersection of the vertical line for the number of lineal feet of pipe to be covered, with the sloping line for the outside diameter of the pipe over the insulation. This gives the approximate number of 48-in. x 100-ft. rolls of material which will be required.

The tank sketch above indicates how the aluminum jacketing is used to weatherproof an insulated tank. Laps should be 3 in. and the vertical laps, so far as possible, should be on the lee side of the tank.

The first course is shown installed, held in place with circumferential aluminum strapping and seals, with the vertical joints secured with aluminum sheet metal screws.

The second course is shown being installed. The belt of material is held in place by a rope while the circumferential aluminum straps and the sheet metal screws are being put in place. Remaining courses are similarly placed.



A Look at the Future:



- *Engineers' Salaries*
- *Education for Rapid Specialization*
- *Founder Societies Build Together*

NOT many of you managed to get to the golden jubilee meeting of AIChE. Although plans had been made to accommodate as many as 3,500 registrants, only 1,800 had appeared by the end of the week.

For those of you who couldn't make it, here are some of the things that were said about your personal stake in engineering as a career.

About Engineers' Salaries

First discussion on the crammed program was "Where Are Engineers' Salaries Headed?" A panel of three engineers and one economist tackled this question in the Rose Garden, 18 stories above Philadelphia's Sunday-slowed Broad St.

Perhaps first-day jitters were to blame, but the discussion never really came down to earth. None of the panelists actually got around to predicting where your salary is headed. Instead they offered a mixture of:

• Long-range hope for better things to come through increased expenditures on research and development (Kraft, The Lummus Co.).

• You never had it so good. Chemical engineers make more money than all other engineers (Peck, Rutgers Univ.). This conclusion was later modified under fire to "the chemical and petroleum industries pay their engineers higher salaries than other industries."

• We wuz robbed. Engineers never catch up with bricklayers and carpenters when you consider the cost of obtaining an engineering education, lost income during the college years and the time value of invested money (De Haven, Rand Corp.).

• The sense of accomplishment that goes with engineering work well done and acclaim from fellow engineers are more important than monetary reward (Nichols, Arthur D. Little, Inc.).

When panel moderator Roy Kinckiner ended the discussion, no one had really answered the question and some pessimistic notes on engineering employment had injected themselves into the question-and-answer period:

How do you tally in the negative salaries of those engineers who have recently been laid off by some chemical, petrochemical and petroleum employers?

What about the new graduates who still haven't found jobs? There aren't very many of them to be sure (one still unemployed out of 25 graduates from Ohio State this year, for example); but we do have some.

Incentives Are Important

It wasn't until the banquet on Wednesday evening that a prominent chemical engineer gave us a probable answer to the Sunday question. Crawford H. Greenewalt, president of the Du Pont Co. was the speaker and here is his prediction:

"I have been told that any responsible individual will do his best, not because he is offered material incentives, but because of some internal compulsion, or because of spiritual satisfaction arising from the knowledge that he has done his task well. Of course, I would not deny either the existence of these internal motivations or their strength as incentives to maximum effort.

"Surely there is much idealism in the world and motivations of the spirit influence every man and woman to some degree. And had mankind reached a sufficiently high spiritual plane, perhaps they would suffice as guarantees of high performance. Human nature, however, must be taken as it is, not as it should be, and I think people will continue to be responsible primarily to self-interest.

"Satisfaction with one's own performance provides some measure of comfort to the participant, to be sure, but I am afraid it is a weak reed upon which to base our future prospects. For satisfaction is largely a subjective matter resulting from self-appraisal, and I am not sure that many of us are sufficiently strict judges of our own performance.

"That inner glow associated with a job well done can all too easily become a resting place for ambition

and a quiet backwater in which to relax. For the question is not only whether we are doing an adequate job, or even a good job, but whether or not we are using to maximum effect the abilities with which we are endowed.

"It is extraordinary performance that makes for high accomplishment and for social and material progress. Average performance is simply not enough, and if we are to enjoy new horizons of the spirit, or of the mind or of the body, we need to be sure that there is a sufficient array of external incentives to make men willing to attempt the really difficult tasks even while recognizing the possibility that they may fail in the attempt."

Applying Mr. Greenewalt's philosophy to engineering salaries means to us that they are headed in only one direction: decidedly upward.

Make Way for Rapid Specialists

You may have wondered how chemical engineering science curricula have been progressing; and how you might be able to use a new graduate who comes to you with a degree in engineering science.

We stopped in Thursday morning to listen to W. H. Corcoran (Cal Tech) and R. R. White (Michigan), among others, discuss the future of chemical engineering education, with particular emphasis on engineering science.

In his usual convincing and authoritative manner, Prof. White explained that the specific objective of engineering education is to develop engineers who possess the background and ability to solve an extremely wide variety of engineering problems—problems which require an extensive knowledge of mathematics, science, engineering science and business.

Such men, he said, must have the ability to specialize rapidly in whatever areas are required by the particular problem at hand.

In the discussion period, Prof. White let the audience in on a little secret. It seems that in trying to keep the education of these future "rapid specialists" as general as possible during their undergraduate days, the engineering courses are delayed to the junior and senior years. By this time the superior students have become so interested in their pursuit of the pure sciences, that they may drop out of engineering science and switch to mathematics or physics as a major field.

In the future, engineering science schools will have to start engineering sooner. Rapid specialization may not be able to wait for the industrial testing ground.

Founders Join Together

They talked about you—each and every one of you—on Tuesday afternoon at the special meeting on the member-gifts campaign.

Sometime soon one of your fellow engineers is going to visit you and ask you to make a pledge for the new United Engineering Center to be built on United Nations Plaza in New York. Total cost of the center will be $10,000,000. Of this, your employers are giving half. Individual engineers will be asked to give less than one-third. (The remainder will be realized from the sale of the existing Engineering Societies Building.)

You may be questioning why you should be asked to make this once-in-a-lifetime pledge. One local-section officer of AIChE phrased it this way:

"When they ask you what you do for a living, what do you say? You say I'm a mechanical engineer, or a chemical engineer or an electrical engineer. Just try the same question on someone in the medical profession and he'll snap right back that he's a Doctor, of course.

"Someday when the United Engineering Center is built and the founder societies take a few more steps toward engineering unity, you'll be able to tell your neighbors that you're an Engineer, without the adjective in front of it. And you'll say it with pride."

This was a voice of the future.

PATENTS

. . . *Are They Obsolete?*

Our industrial and technological economy of today bears little resemblance to that of yesterday. The garret, garage, or basement inventor has given way to coordinated group activity of the industrial research laboratory.

Does this mean that our patent system is obsolete, too?

This is the question that a Senate subcommittee is now considering. In a report to this committee, Prof. Seymour Melman of Columbia Univ. suggests that whatever its past contributions and its values and virtues in other respects, our patent system today contributes little to the progress of science and engineering.

Such a conclusion, without doubt, will be greeted with skepticism by some and with vigorous disagreement by others. In any event, allow us to recommend some fascinating reading for engineers in research and development. Get hold of Senate Resolution 236, Study No. 11, available from the U. S. Government Printing Office at 25¢/copy.

SALARIES

. . . *Up for Salesmen*

Salesmen in American manufacturing companies now are earning about 4.2% more than they did last year, according to a survey of 32,000 sales personnel just completed by the American Management Assn.

However, during the last year the average earnings of consumer salesmen increased 6.9% while industrial products salesmen increased their take-home pay only 3.2%.

Most chemical sales engineers are in the second category.

HOW MANY

. . . *Belong to Unions?*

How many engineers are members of professional unions? How many pay their dues?

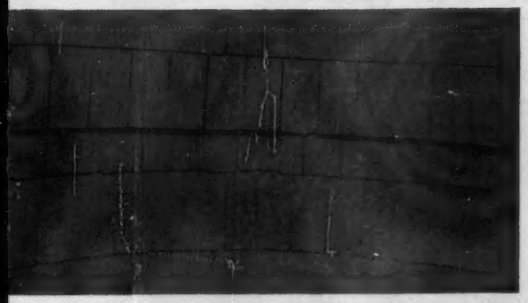
Answers are available in a report recently released by the National Society of Professional Engineers. According to Wayne E. Ault, chairman of the NSPE subcommittee that collected the statistics, the report is intended to help professional engineers and scientists evaluate the facts in the controversial unionization question.

NSPE has counted noses in 28 collective bargaining units of unions that represent engineers/scientists and/or technicians. The units are limited to those in which the professional or technician element is predominant, and does not include over-all unions which have a sprinkling or small percentage of engineers or technicians.

Final score: 40,000 engineers are represented by unions, of whom not more than 30,000 pay dues.

WE wouldn't be in business, if YOU couldn't

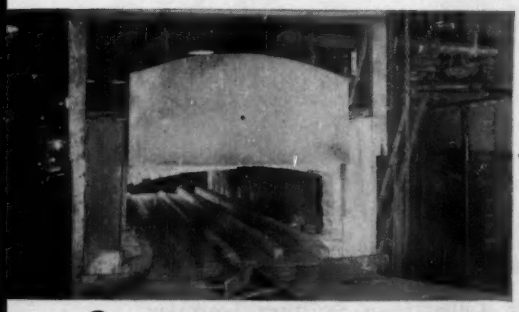
cut costs with these unusual refractories!



A Nothing resists abrasion like an abrasive, such as silicon carbide. Here, for example, is a CARBOFRAX lining that outlasted hard-fired brick on the order of 3 years to 6 months. That's why so many operators are using CARBOFRAX linings in dust collectors, downcomers, coke chutes, and similar equipment exposed to severe wear.



B Pictured here is the oil-fired furnace mentioned in the copy. It's used for working 450-lb. drill bits. The dull bits are heated in the right-hand opening to 2000 F, then dressed and returned to the left opening for tempering at 1450 F. At the time of this photo, our refractories had been used for well over 3000 hours—were still in good condition.



C The three parts of this furnace that take the most abuse are each made of CARBORUNDUM's super refractories. The hearth and skid rails are silicon carbide. The piers are our electric furnace mullite—still going strong after five years. The skids, when pictured, had been in service three years with **no** replacement necessary.

Take advantage of the one *good* thing to come out of the recession: EXTRA TIME . . . time to look around . . . time to spot areas where better materials will give you better service—and help cut your operating costs.

For instance: Those "vulnerable" areas in your furnace—i.e. areas subjected to flame impingement or heavy loads, or exposed to abrasion or corrosion. Or other "working" areas where heat must pass *through* the refractory. In these spots, you may profit handsomely by substituting one of our special-purpose refractory materials. Materials designed *specifically* to meet these conditions.

A **For example:** One customer replaced hard-burned, acid-proof brick in the vertical wall area of a cyclone dust collector with our CARBOFRAX® silicon carbide lining. After three years' service, the CARBOFRAX lining still shows practically no wear. Whereas before, the lining was badly cut out after only a few *weeks*. Quite a saving! . . . in materials, in labor, in downtime.

B **For example:** In another furnace, 300-lb. annealing baskets and 50-lb. motor heads were pushed directly over a fireclay hearth. But maintenance costs were so high that a CARBOFRAX hearth was substituted. This not only solved the maintenance problem, but also transmitted the heat rapidly —and made possible *a saving of one third in fuel.*

C **For example:** The sidewall, backwall and main arch of an oil-fired furnace were replaced with Carborundum's super refractories because the operator was getting only three months life. After the changeover, life increased 300%!

Granted, Carborundum's refractories cost more. But they also *save* much more—in terms of refractory life . . . furnace downtime . . . and maintenance costs. They also *do* more—in terms of higher furnace output . . . faster heat transfer . . . and increased efficiency. In short, *we* wouldn't be in business if *you* couldn't cut costs with super refractories.



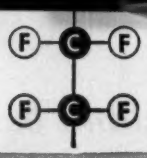
Here's how you can start cutting costs:
It will take less than an hour to read these two booklets about the applications — and **properties** — of Carborundum's unique, new super refractories. Send for them today.



Subscription to "Refractories"
is yours for the asking. This technical brochure is published approximately every other month; contains a wealth of information on new refractory materials, lining techniques, etc. Offer limited, so write soon.

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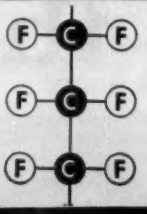
PRACTICE . . .

CORROSION FORUM

EDITED BY R. B. NORDEN

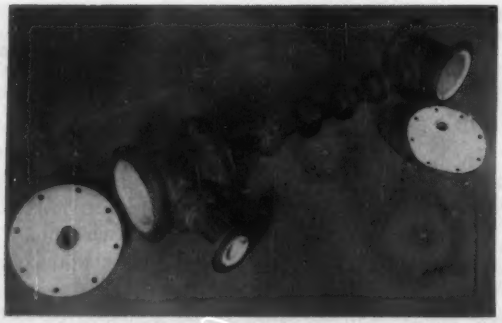


BUBBLE CAP: from better methods.

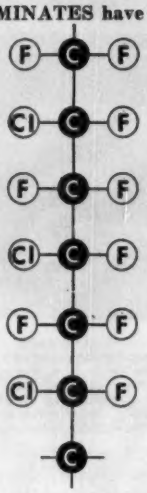




GLASS LAMINATES have high strengths.



TEFLON-LINED pipe handles variety of corrosives.



Modified compositions and improved fabrication techinques promise much wider process use of chemically-resistant fluorocarbon plastics.

Fluorocarbon Plastics Take on New Jobs

Recent advances in fluorocarbon plastics—the product of intensive research and development—promise much wider application of this "industructible" material of construction group in the process industries.

Much of the recent work has centered around Du Pont's Teflon or polytetrafluoroethylene (TFE) resin.

One difficult problem with Teflon has to do with forming the plastic into various shapes. This is the area where DuPont engineers have concentrated.

▶ **Annoying Characteristic** — TFE is resistant to all chemicals except molten alkalis, it stands up to temperatures of 500 F., it has almost zero moisture absorption, high strength and a low coefficient of friction. But it has one very annoying property: it does not melt and flow. Instead TFE turns into an amphorous gel above 620 F. (below this TFE

SOLVENT PACKINGS



"We tested one packing after another... but only 'U.S.' could stand up,"

Says CHEMICAL PLANT SUPERINTENDENT

When a leading mid-western chemical company put their new plant into operation in 1955, they faced a problem with pump packings: To find a packing resistant to a combination of solvents, caustic and high temperature—with a minimum of shaft wear.

"We tested one packing after another on our caustic pumps," says the plant superintendent, "and found that U. S. Solvent Packing outlasted any other packing tested *by as much as 10 to 1.*"

Result: No more morale-breaking "clean-up" sessions, production is increased, personal injuries due to leaks have been reduced 75%, and there's no need for rescheduling due to breakdowns.

A "U. S." technician, of course, worked with engineers of the chemical company to develop the right packing for this particular requirement. That's part of the "U. S." service, when needed.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

Mechanical Goods Division

United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

has a crystalline structure). As a gel it flows with great difficulty, and cannot be molded or extruded on standard plastic forming equipment. One approach to this problem is to develop a modification of Teflon, which will act more like a thermoplastic—that is, it will flow under heat and pressure.

▶**One Modification**—A recent result of the modification approach: a copolymer which is currently produced by polymerizing tetrafluoroethylene, with hexafluoropropylene. This resin (FEP) softens at 545 F. and is readily extruded at 650-740 F. Now making pilot-plant quantities, Du Pont is building a new plant at Parkersburg, W. Va., for large-scale production; calls the resin 100-X.

Actually FEP has properties very similar to TFE (chemical resistance, physical, mechanical and electrical properties) except for one important point: it is not recommended for extended exposures to temperatures above 400 F. This is 100 F. below the top limit for TFE.

The melting characteristics of FEP allow it to be molded or extruded on standard equipment. When large-scale production gets going, FEP should be available as corrosion-resistant piping, tubing, rods, sheets and films for process use.

▶**Promising Application**—Probably much of the FEP will go into a new and promising application: lining of steel pipe and overbraided flexible hose. Such linings are now made from standard TFE.

In lined pipe the liner extends over the full gasket face, eliminating the need for separate gaskets.

Fairly expensive—around $18/ft.—Teflon-lined pipe can greatly reduce maintenance and inventory costs in chemical plants faced with severe corrosive conditions. Usually one material is used for mild acid service, another for alkalis, another for strong acids. The lined pipe can handle such a wide range of corrosives, eliminating the need for a great variety of materials of construction in inventory.

Also the fabricators stress the non-sticking properties of Teflon, particularly useful when handling slurries or viscous liquids.

▶**Teflon Competitors**—While Du Pont is the only producer of TFE (and FEP) there are four producers of a closely related fluorocarbon plastic, polychlorotrifluoroethylene (CFE):

- Minnesota Mining and Manufacturing, Jersey City Chemical Div., makes Kel-F.
- Union Carbide and Carbon produces Fluorothene.
- General Chemical Div., Allied Chemical and Dye, has Genetron.
- Acme Resin Corp. makes Polyfluoron.

The CFE plastic can also be molded or extruded on standard equipment. It's a true thermoplastic and it's been formed into pipe and fittings, used to line pipe, made into gaskets, seals, packings. From a dispersion CFE can be coated on a variety of parts. It is tough, it can be heat sealed and will stand temperatures up to 390 F.

One big application for CFE is in the manufacture of a laminate of cloth and Kel-F. This laminate can be cemented to a metal backing.

▶**Some Disadvantages**—CFE is not as resistant as TFE or FEP to some chemicals, particularly highly halogenated and aromatic solvents, where swelling takes place. It is very resistant to acids and alkalis (except molten alkalis).

Also CFE costs about $1/lb. more than TFE. But one of the CFE producers expects their product to be lower in cost than Du Pont's FEP. Preparing for a competitive battle the CFE people are working on improving their extrusion techniques, lowering any degradation which takes place during extrusion, and improving impact resistance.

▶**Let's Live With It**—Another approach to the TFE forming problem is to live with it and try to improve the techniques. This has proved to be a very worthwhile area of investigation.

Usually TFE is fabricated using powder metallurgy methods: Cold forming of powder by compression, then sintering at 700-720 F. until the resin particles coalesce, then cooling below 620 F. Sintered products can be further shaped at a temperature approaching, but below 620 F.

▶**Electrolytic Coating**—Now in the development stage is an electrolytic coating process.

There are two aqueous dispersion resins of Teflon—called 30 and 41X. These are hydrophobic, negatively-charged colloids stabilized by a nonionic wetting agent and dispersed in an aqueous media. The 30 grade has 60% TFE; 41X has 33-35%.

Parts are usually coated with 41X by passing a direct current through the dispersion. Negatively charged resin particles go toward the anode and the water phase migrates toward the cathode. The metal anode is oxidized prior to insertion in the bath. It forms positive ions which contact and neutralize negatively charge TFE particles. Neutralization takes place, and the TFE particles coagulate and deposit on the anode.

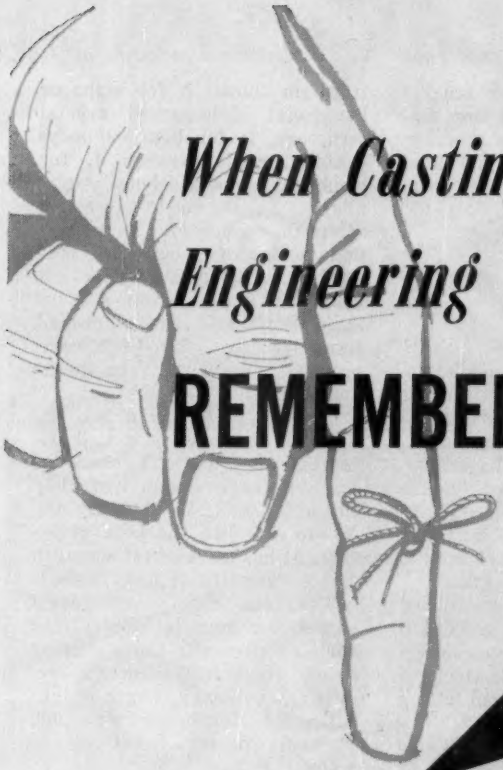
Already beakers and small plates have been coated with a relatively smooth, nonporous TFE deposit.

The Teflon-30 dispersion of TFE is not brand new. It has been used by fabricators for impregnating glass fabric and asbestos as well as a base for films. The sintering step is still necessary with the dispersions.

▶**Lined Pipe**—There are also significant developments in other forms of TFE, aside from dispersions. The lined pipe, fittings, and lined overbraided flexible hose are examples.

The liner itself is now made from Teflon-6 by a paste extrusion process or from fine grinds of the granular resin (such as Teflon-7X) by ram extrusion. Teflon-6, with an ultimate particle size of around 0.2 microns, is blended with an extrusion aid by the fabricator. It is then cold extruded into an oven which removes lubricant and sinters the Teflon. The plastic liners (0.060 to 0.100-in. thick) are then inserted into standard pipe.

Lining of pipe is a tricky business. A number of fabricators use one form or another of the "stretch" technique where the liner is stretched longitudinally at room temperature. This



When Castings Become an Engineering Problem...

REMEMBER THAT

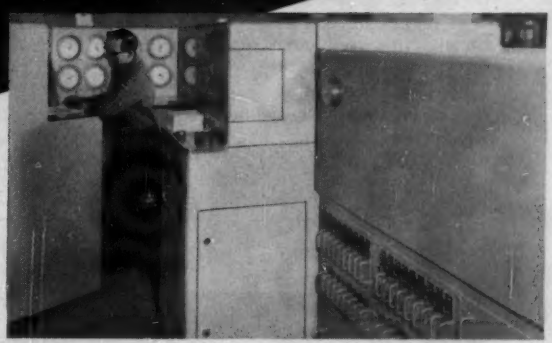
WE CAST ALL 3

There are two facts which may be highly important to you. First, WAUKESHA is comprised of three separate foundries with expert experienced, *specialized* management for each.

1. One foundry casts only Stainless Steel, 300-400 series, Ni-resist and special corrosion resistant formulations.
2. Another casts only "Waukesha Metals" (copper base, high nickel alloys), pure nickel, Monel, brass, bronze, Everdur.
3. The third casts only Aluminum — as cast and heat-treated.

Second, over all three foundries are two laboratory operations, one for quality control and the other for metalurgical research. Both work for your interests. As examples of quality control: a spectrometer checks every heat; formulations can be corrected before the metal is poured. The laboratory also controls all supplied materials.

But perhaps more important to you when you have any problem such as corrosion resistance, heat resistance, galling or machining, is the Research Laboratory. Let it suffice to say that we have solved intricate metallurgical problems for many WAUKESHA customers. And this we offer — without charge — to you. Simply send a print or a pattern and tell us your need. You have everything to gain.



The spectrometer at WAUKESHA for quality-control



Part of the metallurgical laboratories for quality-control and research

Waukesha FOUNDRY COMPANY

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reduces its diameter and it easily fits into the pipe. After insertion into the pipe the liner is permitted to relax. Then the assembly is heated, the liner returns to its original diameter, giving a snug fit. Ends of the liner are flared over the flange faces.

▶ **Teflon Yarn**—Recent developments in forming also permit the production of TFE yarn, an ingredient in improved braided packings.

There are three such TFE packings, one has asbestos fibers impregnated with TFE from an aqueous dispersion, another consists of ribbons of TFE tape twisted and braided. The tape has poor porosity, calling for high gland pressure for sealing, so some asbestos yarn is usually included.

A recent development is based on multifilament yarn spun from TFE fibers. Since this is compressible, seals can be obtained at relatively low gland pressures and the packing is 100% TFE. The fiber tensile strength is about 30 times unoriented Teflon. It is usually impregnated with 10-35% Teflon from a dispersion.

New Easy-to-Work Titanium Alloys

Availability of three new high-strength heat-treatable titanium alloys has been announced by Crucible Steel Co. of America.

The new alloys have the unique advantage of being readily formed in the solution-treated or soft condition, and then strengthened by simple thermal aging treatments.

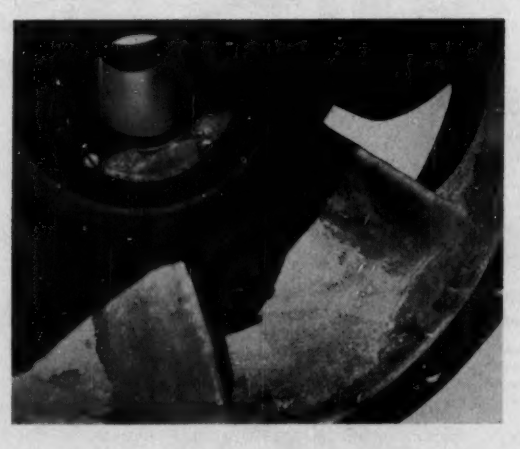
The three alloys are called B-120 VCA, C-105 VA, and C-115 AMoV. Numbers in each designation refer to the yield strength in 1,000 psi. and the final letters refer to alloying elements.

The first letter indicates one of the three major categories of titanium alloys: A for alpha or hexagonal close-packed crystal structure, B for beta or body-centered cubic crystals, C for combined alpha and beta. Alpha alloys have good all-round strength, stability, toughness and weldability; beta has best strength and formability but not best long-time high temperature stability; while the combined structure has the best compromise of strength, formability and stability.

Crucible Steel claims B-120 VCA is the most versatile titanium alloy yet developed. It contains large amounts of alloy elements—13% V, 11% Cr, 4% Al—to stabilize the beta structure. It has the highest strength and formability of any Ti-alloy.

The beta alloy seems idealy suited for missile applications such as pressure tanks, casing skins, structural members--requiring excellent strength-weight ratios for a few hours up to 1,000 F. and shorter times up to 1,400 F.





Corrosion-Resistant Putty Puts New Life Into Sea Water Pumps

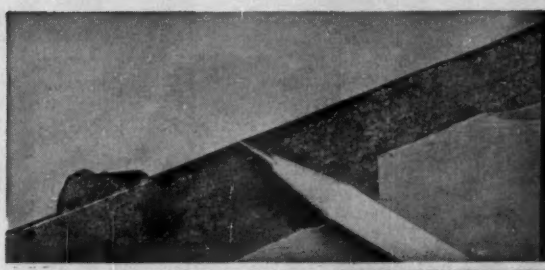
In an unusual application, a corrosion-resistant putty—originally developed for aircraft and missiles—is now used to protect vertical circulating pumps from sea water attack. The pumps, at San Diego Gas and Electric Co., San Diego, Calif., feed steam turbine condensers and are subject to severe corrosive and abrasive attack. Diffuser vanes become serrated (see photo left) and pits formed in the diffuser shell.

The putty (Narmco Resins and Coatings, Costa Mesa, Calif.), used to build up the attacked vanes and housing (see photo right), appears to retain some surface resiliency. Abrasives bounce off without harming the surface.

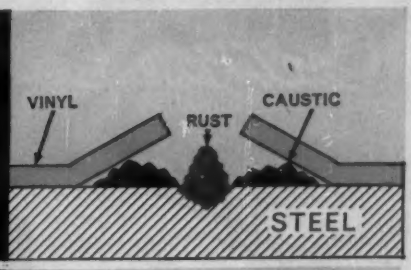
In their tests, the San Diego utility first cleaned off all pump components by sandblasting. Putty was applied and a woven fiberglass matrix placed on the surface and coated with a liquid resin. This was covered with fiberglass cloth and coated again with resin.

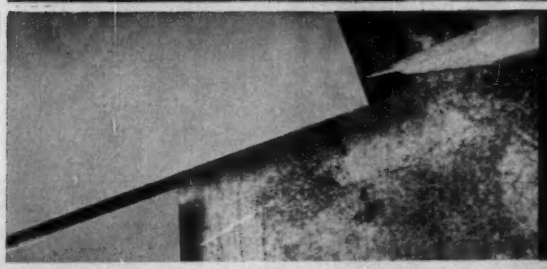
PUZZLED ABOUT PRIMERS?

Here are tests you can duplicate

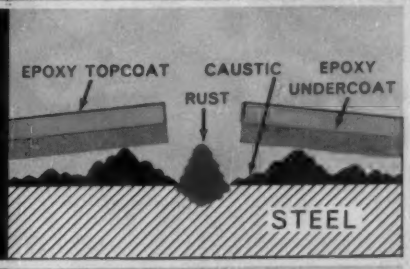


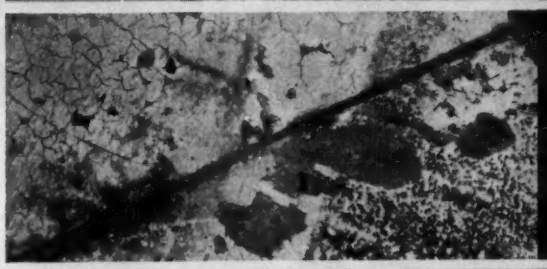
TEST 1—One coat of self-priming vinyl. Coating breaks away (L) due to severe undercutting (R), exposing metal to progressive corrosion.



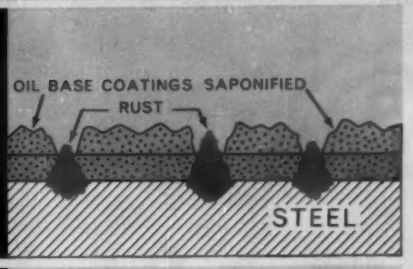


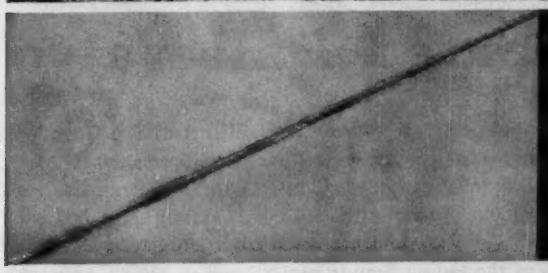
TEST 2—Epoxy primer, epoxy topcoat. Coating lifts off in single sheet (L) as adhesion fails (R), exposing entire surface to corrosion.



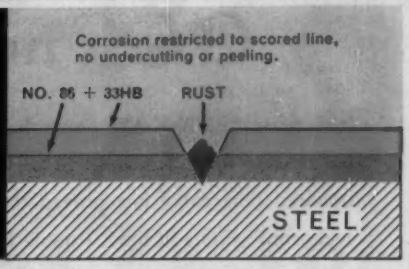


TEST 3—Oil primer, oil topcoat. Both coats fail completely (L) as underfilm caustic reacts on their oils to form soaps (R).





TEST 4—Amercoat's No. 86 inhibitive primer and No. 33HB vinyl topcoat. Corrosion restricted to scored line (L), no undercutting or peeling (R).



The purpose of these accelerated tests is to show what happens when various types of coatings are exposed to a typical corrosive environment. Four clean steel panels, free from mill scale and rust, were coated with different combinations of primers and topcoats. Each was scribed to bare metal and immersed in salt water in the presence of free oxygen, for two weeks.

As caustic deposits formed over cathodic areas of the steel in tests 1, 2 and 3, failure occurred in three ways. The vinyl, though not directly attacked, was undercut as caustic spread beneath the film and destroyed adhesion. The epoxy coating, known for critical adhesion to smooth metal, proved impervious to caustic attack. It was, however, lifted in its entirety as moisture spread beneath the surface. The entire oil paint film was quickly penetrated by the salt solution, creating widespread corrosion and caustic formation. The caustic then reacted with the oil to saponify the film.

In the fourth test the corrosion was limited to the score mark. Reason: Amercoat No. 86 Primer resists undercutting and adheres tenaciously, inhibiting electrolytic corrosive action.

The conclusions are clear. To provide long term protection in corrosive service, start with Amercoat No. 86 Primer, which provides a sound and lasting base for quality topcoats such as Amercoat No. 33HB.

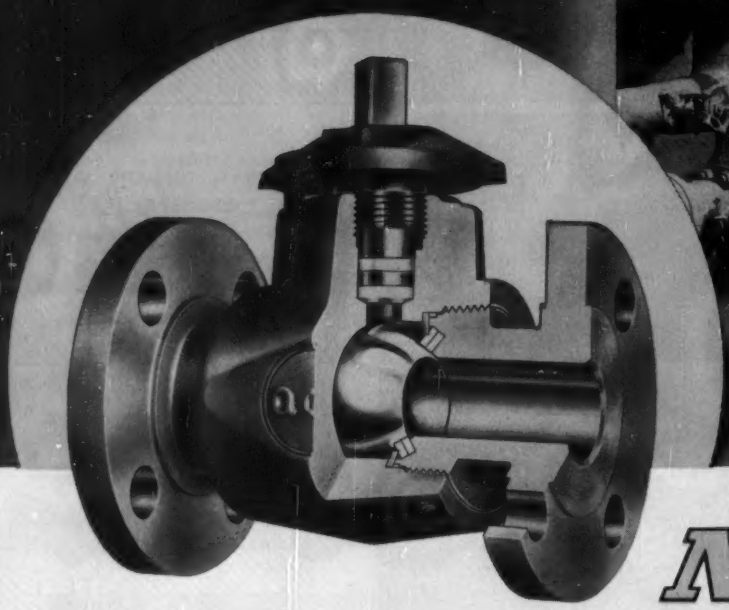
Write today for complete data on Amercoat No. 86, and have the details on hand when planning your next important coating job.

Amercoat CORPORATION

109 Dept. AH

4809 Firestone Blvd., South Gate, Calif.

A new
service-proved product
of W-K-M's
Creative Engineering





NEW...

ACF non-lubricated Ball Valve

This newest of W-K-M's products is offered to valve users only after hundreds of tests in all types of service. This valve has proved that it will provide leakproof sealing in long, trouble-free service.

DESIGNED FOR SUPERIOR PERFORMANCE

Full Bore Conduit: Full, round conduit through body and ball assures full flow through valve. No restriction, no turbulence, no more friction or pressure loss through the valve than through an equivalent length of pipe.

Leakproof two-way seal: The ball is suspended between Teflon seats under compression, assuring leakproof service at rated working pressures or vacuum, indefinitely. Actual seating surfaces are sealed away and protected from any abrasive action of the lading flow in either open or closed position.

Other advantages: Minimum parts, minimum maintenance. Quarter-turn opening and closing. Corrosion resistant. Recommended for temperatures to 250° F.

Available in carbon steel (ASA 150 lb., 300 lb.), and semi-steel (200 lb., 400 lb.); sizes range from ½" through 6".

WRITE FOR CATALOG 1000

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

5810



New acf Ball Valves tested up to 3½ years with these ladings without a single failure

Acetate
Crude ammonia liquor
Aviation fuel and Stoddard solvent
Propane
Toluol
Methylethylketone (MEK)
Alkaline slurry
Jet engine fuel (test cells)
Naphtha and coal tar solvents
Paint cleaner and thinner
Liquid soaps, DDT and chlordane
Vinyl chloride
Butadiene liquid
Copper ammonium acetate
Carbon bisulphide
Cleaning naphtha
Lime and soda ash slurry
Riboflavin media
Gasoline (tank truck)
Helium gas
Coke oven by-product gas
Gasoline (tank car)
Chlorinated solvents

W-K-M

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES

This Month's Top Projects:

Shell Chemical Corp., "expressing confidence in the future of the economy," has awarded contracts for construction of remaining glycerine production facilities at Norco, La. As part of the $10-million program, Lummus Co. will engineer and build an acrolein unit at Norco scheduled for completion late in 1959.

Michigan Chemical Corp. has completed plans for a new seawater magnesia plant at Port St. Joe, Fla.; design capacity will be 125-150 tons/day with provision for a subsequent expansion to 300 tons/day.

Weyerhaeuser Timber Co's. chlorine plant at Longview, Wash., is adding 70 tons/day capacity raising plant's total capacity to 140 tons/day. New installation will be completed by end of this year.

Rio Tinto Dow, Ltd., has announced plans for a thorium plant to be erected in the Blind River-Algoma area, first such plant in Canada. Expected to be operating by May 1959, unit will turn out crude thorium concentrates, metallurgical-grade thorium and thorium oxide from byproducts of uranium mining operations in the area.

HEF, Inc., is starting construction on a multimillion-lb./yr. ammonium perchlorate plant adjacent to Hooker Chemical Corp.'s Columbus, Miss., plant. Ammonium perchlorate is used as an oxidizer in solid fuels for rockets and missiles.

Olin Mathieson and Sun Oil are forming a company to manufacture urea. Present plans call for a 73,000-ton/yr. urea plant to be tied to Sun's ammonia plant at its Marcus Hook, Pa., refinery.

Phillips Petroleum Co. is beginning operation of its 1,725-ton/day uranium ore processing mill in McKinley County, N. M., making Phillips one of nation's largest yellow cake producers.

B. F. Goodrich Chemical Co. announces plans for a new antiozonant production facility at its recently expanded Henry, Ill., plant. Construction on new processing unit will begin in September with completion slated for spring of 1959. New unit will increase personnel requirements at the Henry plant by about 10%.

Foster Grant Co.'s new million-dollar nylon-6 plant at Manchester, N. H., is now in full production, producing at a rate in excess of 3 million lb./yr.

Hooker Chemical Corp. is planning another million-dollar expansion of its sodium chlorate plant at Columbus, Miss., more than doubling plant's original 12,000-ton/yr. capacity. To be completed by April 1959, expansion will

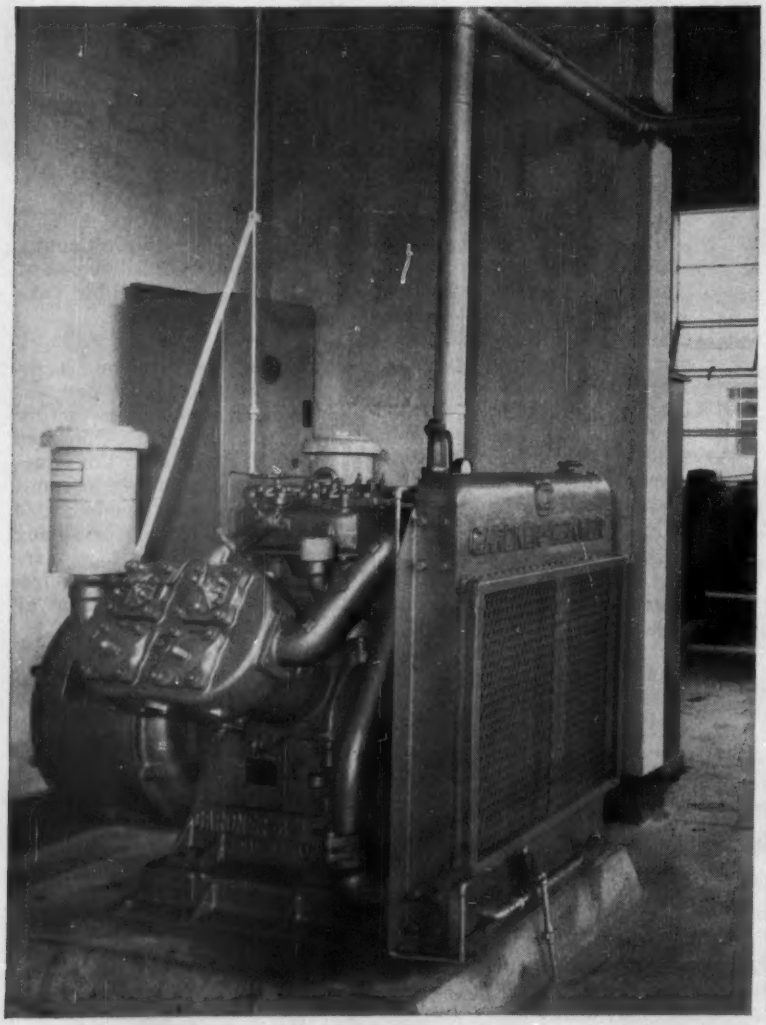
GARDNER DENVER

Compact and efficient, the Gardner-Denver WB supplies low-cost compressed air power from a small corner of your plant. The "W" design saves floor space. Balanced high- and low-pressure cylinders eliminate vibration and the need for expensive foundation. Pump circulates cooling water around cylinders and separate valve chambers. That's the story of WB quality. Want details? Send for Bulletin WB-10.

Stationary air compressors . . . tank-mounted compressor outfits . . . oil-free air compressors . . . whatever your compressed air needs, see your Gardner-Denver compressor specialist first. Gardner-Denver Company, Quincy, Illinois.

Compact . . . efficient

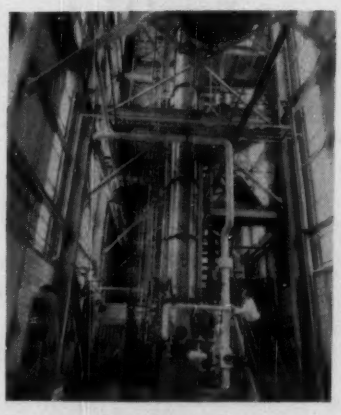
WB Two-Stage Compressor



FIRMS . . .

boost Hooker's total investment at Columbus up to $7 million.

International Minerals & Chemical Corp. has lifted production of flake mica to 120 tons/day with completion of new grinding facilities at Davy Crockett Lake near Greenville, Tenn.



Ciba Pharmaceutical's Badger-engineered solvent recovery unit is now on stream at firm's Summit, N. J., plant: Shown above is one of three quick-drain distillation columns. By centralizing recovery operations, formerly handled by individual manufacturing sections, Ciba looks for greater economy and safety.

Norwich Pharmacal Co.'s new Furoxone plant at Norwich, N. Y., is now in full production on a three-shift basis. Furoxone is one of company's antimicrobial nitrofurans used in both human and animal medicines.

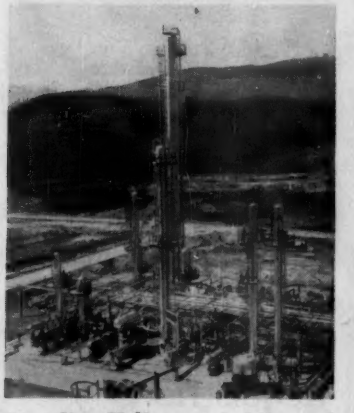
Stauffer Chemical Co. is now turning out boron trichloride —raw material for exotic chemical fuels—in the firm's Niagara Falls, N. Y., plant. Stauffer now ships tank car quantities to rocket-fuel makers throughout the country.

Scientific Design Co. will design an ethylene oxide-glycol plant for Japan's Mitsubishi Petrochemical Co., approximately

doubling Japanese ethylene oxide production. This is second unit to be erected in Japan using SD's air-oxidation process.

Hofman Laboratories, manufacturer of liquid oxygen and nitrogen storage and transportation equipment, has expanded into a new 22,000-sq.-ft. plant in Hillside, N. J. New unit is being used for assembly and production testing.

Wyandotte Chemicals Corp. has completed expansion of research facilities at firm's Wyandotte, Mich., complex. Expansion includes laboratories and test cells for a wide range of corporate and Defense Dept. research projects dealing with high temperatures and pressures and toxic materials.



Canadian Kellogg, subsidiary of M. W. Kellogg Co., is winding up construction on a 20,000-bbl./day refinery being built for British American Oil Co. at Vancouver, B. C. Shown above are last touches being put on an alkylation unit.

Superior Separator Co., Hopkins, Minn., has begun construction of a new 18,500-sq.-ft. research and development building at Hopkins. Firm manufactures materials handling equipment for agriculture and industry.

Container Corp. of America has drawn up final plans for a $2.5-million folding carton plant in the new Dallas-Ft.



Fire-safe air hoist

easily handles loaded filter plates

This Gardner-Denver air hoist quickly but gently lifts a plate assembly cartridge out of a Sparkler filter at Dow Chemical Company's Midland, Michigan, Resinous Products Laboratory. Nonsparking air motor makes this handy hoist ideal for jobs in highly explosive chemical atmospheres. In addition to being fire-safe, Gardner-Denver air hoists provide easily controlled speed for a swift, steady lift—with smooth starts and accurate stops.

Keller air hoists in capacities from 150 lb. to two tons. Write for Bulletin 80.

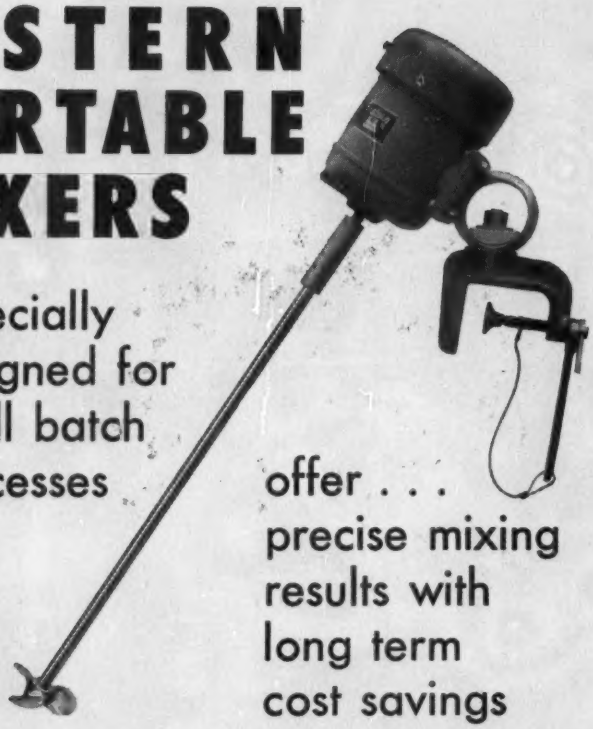
ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

EASTERN PORTABLE MIXERS

especially designed for small batch processes



offer . . . precise mixing results with long term cost savings

Eastern Portable Mixers are especially designed for dependable, low cost service in small batch processes. Where fixed mounted installations are not required, Eastern's Portables offer greater versatility, ease of handling, and long term cost savings.

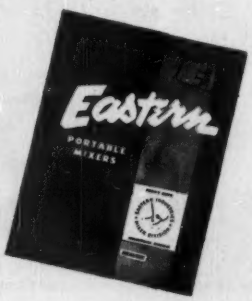
Speeds of 420, 1125, and 1725 R.P.M. rated from 1/20 to 3 H.P. are standard, with variable speed and air-driven models also available. Motors in all standard types can be supplied in semi-enclosed, totally-enclosed, or explosion-proof construction. Shafts and single or dual propellers are available in a choice of alloys for all service requirements. New optional ball-swivel clamp as illustrated, permits easy adjustment of mixer position in tank.



For a personalized analysis of your mixing problems, send details to Eastern engineers. A recommended solution will be furnished promptly and without obligation. For a helpful guide to mixing fundamentals, write for "Handbook of Fluid Mixing."

NEW PORTABLE MIXER BULLETIN

Eastern's improved line is included in the revised Portable Bulletin No. 530-B.

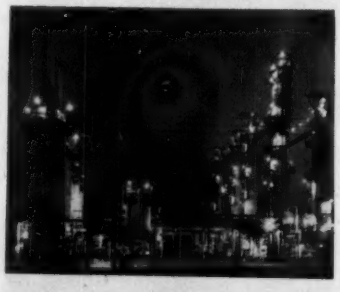


Eastern INDUSTRIES, INC.
MIXER DIVISION
Regent Street
East Norwalk, Conn.

FIRMS . . .

Worth industrial district. New building will contain 195,000 sq. ft., housing production operations formerly carried on in Ft. Worth.

Hungarian Chemical Works will soon begin commercial manufacture of Perlon—this year's production amounting to around 80 tons—allowing a substantial reduction in Hungary's imports. Hungary's Chemical Works will also start production of polyvinyl chloride towards the end of this year.



Gulf Oil Corp. has swung its new 26,000-bbl./day catalytic reformer into full operation at its Port Arthur, Tex., refinery. Output from new facility will go into motor gasoline.



MERGERS & ACQUISITIONS

Ashland Oil & Refining Co. has acquired the Ohio Div. of Anderson-Prichard Oil Corp. The Ohio Div. maintains distribution centers for solvents and chemicals in seven midwestern cities.

Beckman Instruments has sold its Helipot Div. plant at Newport Beach, Calif., to Louis Lesser Enterprises in a multimillion-dollar transaction. Helipot personnel and production facilities will be moved to a newly expanded plant at Beckman headquarters in Fullerton, Calif.

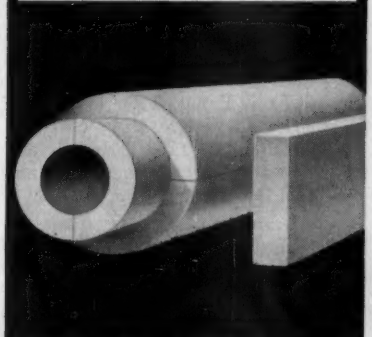
Thompson Products and its affiliate, Ramo-Wooldridge

RUBEROID

Calsilite

ONE-LAYER INSULATION!

Now a modern molded calcium silicate insulation for use on today's high temperature pipes and vessels. Insulates with only *one* layer, providing a constant co-efficient of conductivity. Available in various thicknesses of pipe coverings and blocks, Calsilite is insoluble in water, can withstand normal acids and alkalis . . .



FOR SOAKING HEAT UP TO 1250° F!

- Light weight
- Resists abuse
- Easy to cut and mitre
- One layer does the complete job
- Absorbs moisture without disintegration

For complete details, write:

The RUBEROID Co.
INDUSTRIAL PRODUCTS DIVISION
500 Fifth Ave., N. Y. 36, N. Y.
PIONEERS IN
CALCIUM SILICATE INSULATION

FIRMS . . .

Corp., have signed a merger agreement. New company, to be named Thompson Ramo Wooldridge Corp., will have combined assets of around $200,000,000.

U. S. Chemical Milling Corp. has purchased all outstanding stock of the Paul Omohundro Co., manufacturer of fiber glass laminated structures for military and commercial applications. This marks USCM's fourth acquisition in a program to establish firm as a comprehensive subcontractor to aircraft and missile contractors.

Petro-Tex Chemical Corp. has taken over controlling interest in Grand Central Rocket Co. of Redlands, Calif., from Tennessee Gas Transmission Co. Petro-Tex is owned jointly by Tennessee Gas and Food Machinery & Chemical Corp.

Sun Chemical Corp. has announced purchase of Coating Materials Laboratories, Nutley, N. J., manufacturer of a diversified line of industrial coatings and finishes. New company will be operated as an autonomous division in Sun's Paints & Finishes Group.



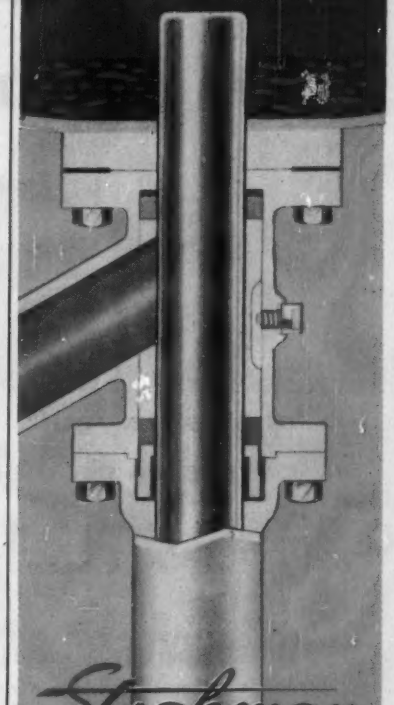
NEW LINES

Union Carbide Chemicals has just introduced potassium sorbate, a water-soluble fungistatic agent for foods. New product, a white crystalline powder, will complement Carbide's Sorbic line of food mold inhibitors.

Davison Chemical now has available in ton quantities a variety of non-nuclear uranium products from its nuclear reactor materials plant in Erwin, Tenn. Firm can now supply sodium diuranate, ammonium diuranate, uranyl

a FLUSH BOTTOM VALVE *that* WILL NOT CLOG UP!

Designed for Chemical and Pharmaceutical Industries



Strahman

RAM TYPE
Drain Valves

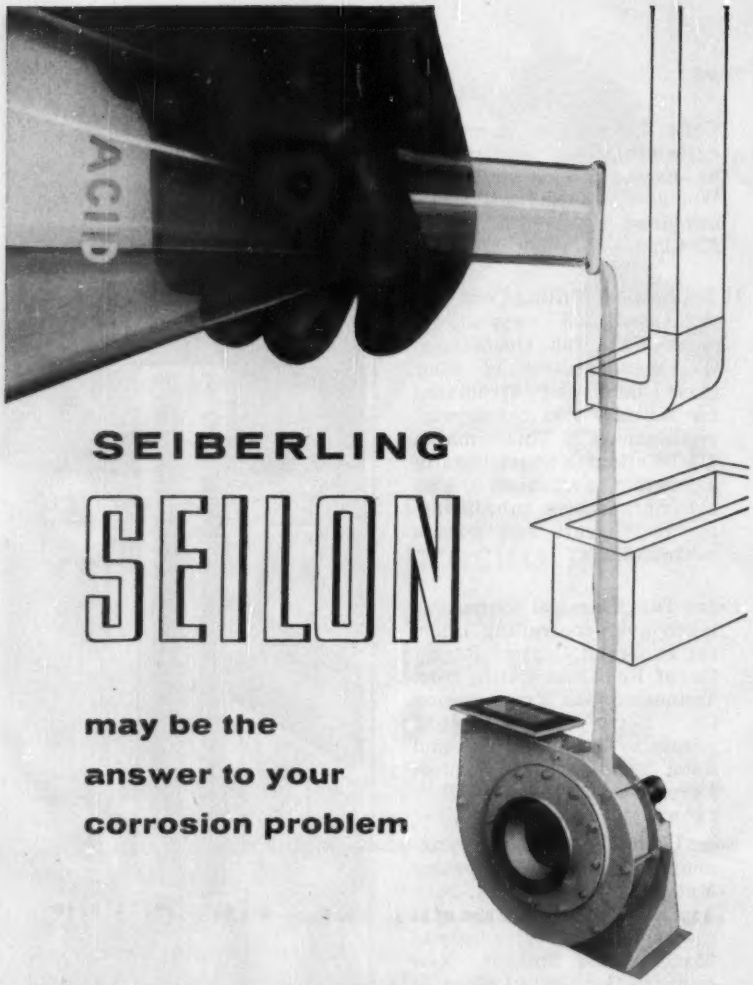
The Strahman Drain Valve is the only valve that cannot clog up. It is so designed that in the closed position the piston or ram extends up into the tank thus preventing any possibility of the outlet becoming plugged.

In the open position, full and unobstructed flow is assured as the piston is drawn down into the bonnet leaving a completely open passage for the material passing through.

Write direct for complete catalogue



STRAHMAN VALVES, INC.
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NEW YORK 13, U.S.A.



SEIBERLING

SEILON

may be the answer to your corrosion problem

SEILON, an unplasticized polyvinyl chloride, is chemically resistant to most acids, salts, alkalies, and oils. It has high molecular weight, excellent chemical, electrical and thermal properties. Seilon is available in Type I (normal impact) and Type II (high impact) grades.

Fabricators working with Seiberling Seilon have solved complex corrosion problems in many industries as Seilon is easily fabricated. It is produced in industrial grey sheets and plates which can be sawed, machined, hot formed, hot gas welded, or solvent bonded.

SEILON could be the answer to your corrosion problem. Why not write or phone us and let us advise you?

Plastics Division

SEIBERLING
RUBBER COMPANY

NEWCOMERSTOWN, OHIO Phone 8-8304

FIRMS . . .

nitrate, uranium oxides (UO_2, UO_3, U_3O_8), uranium tetrafluoride and uranium metal.

Kaiser Aluminum & Chemical Sales now has primary aluminum shot available for use in steel and chemical industries. Standard shot is ⅜ in. in dia. with minimum 99% aluminum content.

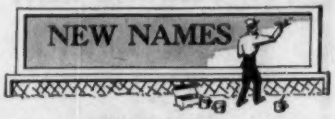
Resistoflex Corp., Roseland, N. J., has licensed BTR Industries, London, Eng., to manufacture and sell its complete line of Teflon products.



NEW LOCATIONS

Ralph M. Parsons Co.'s headquarters has been moved to 617 W. Seventh St., Los Angeles 17, Calif. Move consolidated over 1,000 administrative and engineering personnel in a single building.

International Minerals & Chemical Corp. has relocated its administrative offices in a new center in Skokie, Ill., 17 mi. from downtown Chicago.



Petrocarb Equipment, Inc., has changed its corporate name to simply Petrocarb, Inc., following a vote of the stockholders and directors.

Hooker Chemical Corp. is the new name of the continuing company formed by merger of Hooker Electrochemical Co. and Shea Chemical Corp.

Du Pont's Specialty Products sales section of the Freon Products Div. has been renamed the Fluoro Solvents & Chemicals section reflecting increasing use of fluorinated hydrocarbons in chemical applications.

CALENDAR

American Institute of Chemical Engineers-American Society of Mechanical Engineers, Second National Heat-Transfer Conference, Edgewater Beach Hotel.
Aug. 18-21 Evanston, Ill.

Gordon Research Conference, Inorganic Chemistry, New Hampton School.
Aug. 18-22 New Hampton, N. H.

Gordon Research Conference, Chemistry of Adhesives, New Hampton School.
Aug. 25-29 New Hampton, N. H.

The Combustion Institute, 7th international symposium, Oxford University.
Aug. 28-Sept. 3 Oxford, England

Second International Conference on the Peaceful Uses of Atomic Energy, sponsored by the United Nations.
Sept. 1-13 Geneva, Switzerland

Cryogenic Engineering Conference, Massachusetts Institute of Technology.
Sept. 3-5 Cambridge, Mass.

Federation of Belgian Chemical Industries, 31st International Congress of Industrial Chemistry.
Sept. 7-20 Liege, Belgium

American Chemical Society, 10th national chemical exposition, International Amphitheatre.
Sept. 9-12 Chicago, Ill.

Technical Assn. of the Pulp and Paper Industry, 3rd International Mechanical Pulping Conference, Chateau Frontenac.
Sept. 10-12 Quebec, Que.

The Society of Chemical Industry, travelling conference to view Canadian industry, starts at Chateau Frontenac.
Sept. 11-23 Quebec, Que.

American Assn. of Textile Chemists and Colorists, Delaware Valley Section meeting.
Sept. 12 Wilmington, Del.

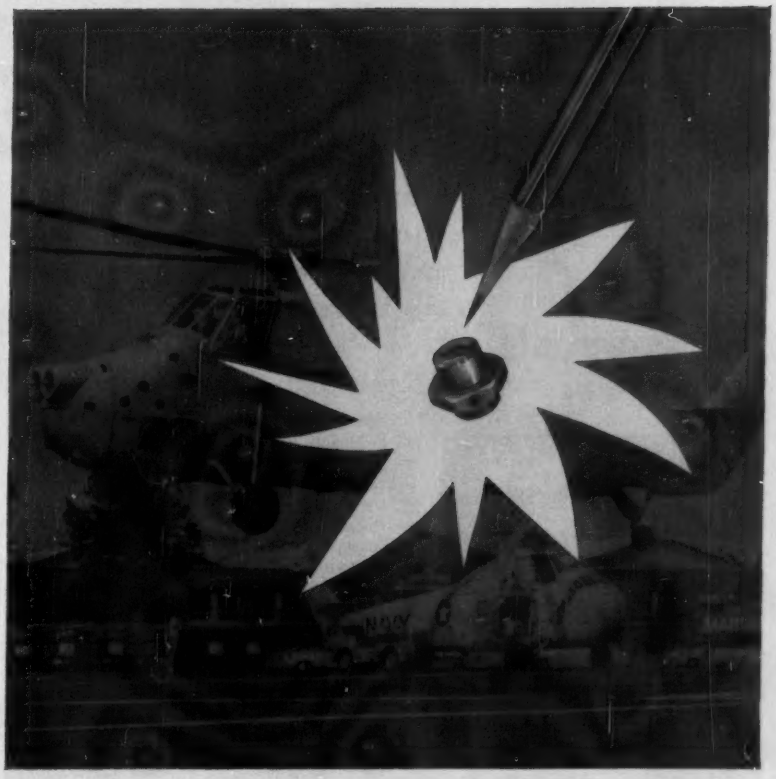
Society of Plastics Engineers, Technical conference: Plastics in Automotive Application, St. Clair Inn.
Sept. 12-13 St. Clair, Mich.

Instrument Society of America, 13th annual Instrument-Automation conference, Convention Hall.
Sept. 15-19 Philadelphia, Pa.

Canadian Agricultural Chemicals Association, 6th annual meeting and conference, Fort Garry Hotel.
Sept. 15-17 Winnipeg, Manitoba

Technical Association of the Pulp & Paper Industry, 3rd International Fundamental Research Symposium, Queen Elizabeth Hotel, Montreal, P. Q.
Sept. 15-17 Montreal, P. Q.

National Industrial Conference Board, 6th annual Marketing Conference, Waldorf-Astoria.
Sept. 17-19 New York, N. Y.



16 Spraco Nozzles help the new lightweight G.E. T58 engine pack the punch of a heavyweight!



At the heart of General Electric's new T58 turboshaft engine — a revolutionary new power plant for helicopters that packs over 1,000 horsepower into a 59″ long, 16″ diameter, 325 pound frame — are 16 precision built steel spray nozzles.

These are special nozzles, developed for the engine by Spraco engineers. Their critical function: to feed just-right amounts of fuel into the combustion chamber.

This development is another example of the hand-in-glove cooperation, engineering service, and product quality you can expect from Spraco whenever you have a spray nozzle problem.

FREE—*The most complete spray nozzle catalog ever published. Send for your copy today!*

SPRAY ENGINEERING COMPANY,
115 Cambridge Street, Burlington, Mass.

SPRACO

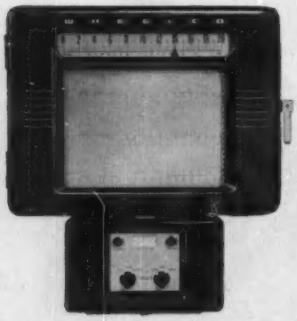


THE MARK OF QUALITY

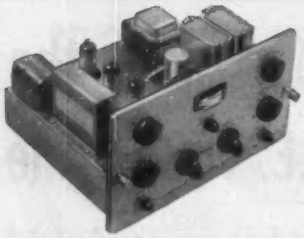
BARBER COLMAN

Wheelco Instruments

Need proportional reset and rate action? Choose from four controller types – that include magnetic modulation – by Wheelco



Start with this production-proved Wheelco Series 8000 recorder-controller and add the MM Series controller* from four types (three magnetic modulated) available to insure getting the best installation for your needs. This customizing of systems at standard cost is another example of Wheelco's constant effort to improve performance while holding down costs. Advance design features include plug-in components and tamperproof covers to protect critical adjustments.



MMC-Current Output Type—Flexible in adaptation to final control elements including saturable reactors, electropneumatic transducers, electro-hydraulic transducers, etc. . . . proportional band adjustable from 2 to 200% of controller range . . . reset action from 0 to 63 repeats per minute . . . rate action adjustable from 0 to 5.5 minutes.



MMP Position Type—Together with potentiometer can position a valve, valve positioner, or other positioning device . . . reset action adjustable from 0.6 to 100 repeats per minute . . . proportional band adjustable from 2 to 200% of controller range . . . rate action adjustable from 0 to 5.5 minutes.



MMD Duration Type—With potentiometer regulates input by adjusting on-time of a contactor on either electrical or fuel-fired installations . . . particularly adaptable when upsets are fast and recovery slow and when they are frequent and of large magnitude . . . keeps overshoot at startup or control point to minimum.

MP Proportional Positioner—Transistorized and printed circuit unit (not shown) where constant voltage source is available as reference voltage . . . mounts inside instrument . . . adjustable from 2 to 40% of recorder range.

*Also usable with Wheelco 2000 and 9000 Series.

BARBER-COLMAN COMPANY

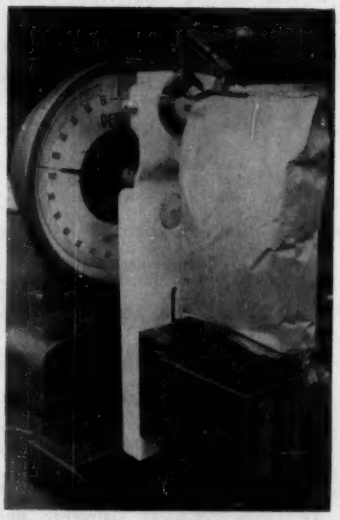
Dept. H, 1585 Rock Street, Rockford, Illinois, U.S.A.

BARBER-COLMAN of CANADA, Ltd., Dept. H, Toronto

NEW EQUIPMENT . . .

(*Continued from p.* 100)

Three sizes are available. Models 15 and 24, constructed from stainless steel and bronze, have capacities of 60 and 200 gph., respectively. Model 36, designed to use refined evaporated salt only, has a reinforced-resin body and PVC piping; its capacity is 400 gph. **—Diamond Crystal Salt Co., St. Clair, Mich. 100D**



Packing Settler

Settles any material being packed into bags.

The new Stoker Settler effectively settles material being packed without transmitting vibrations to the weighing mechanism of the packer. A simple adjustment controls the settler's intensity and frequency to meet product characteristics.

Designed for Model B Stoker packers, and other packers with minor modifications, the settler is claimed to assure precision weight accuracy and improved package appearance.—**H. L. Stoker Co., 111 South Ave., Claremont, Calif. 172A**

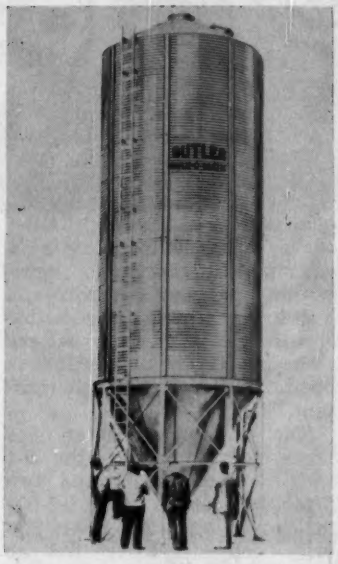
Digital Computer

Gives automatic record of operating conditions.

A new general-purpose digital computer will soon be put through its first paces at a

210,000-kw. steam station of the Louisiana Power & Light Co. Known as the Operational Information System, the unit features a transistorized-computer heart utilizing a memory capable of storing 2,048 pieces of information; provisions are made for increasing this storage to 16,384 pieces.

At the steam plant, the computer will keep tabs on 250 different process temperatures. Should any of these vary significantly from programmed operation, an alarm will sound and a special unit will print out the reading and indicate the trouble spot. The system will also periodically print 100 other variables for engineering and accounting records.—**Daystrom, Inc., Systems Div., La Jolla, Calif.** 172B



Bulk Storage Tank

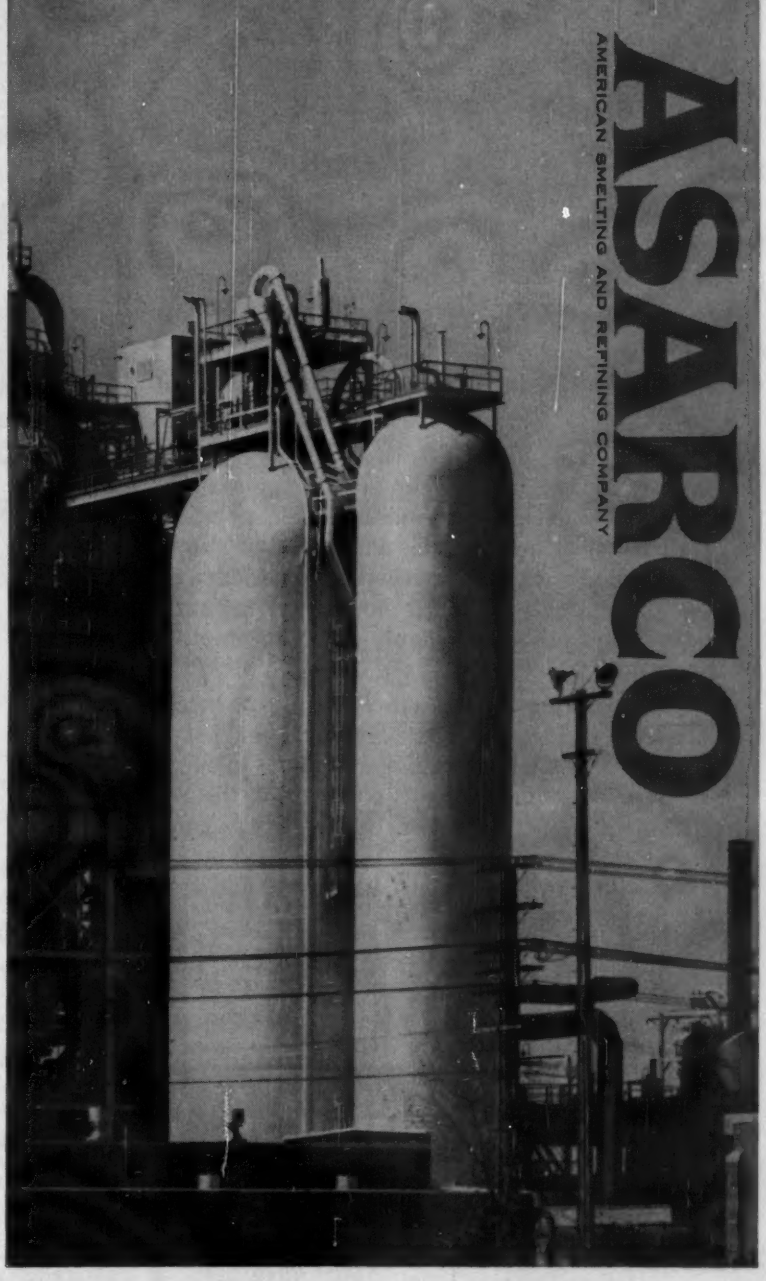
Holds more than two rail cars of granular solids.

Newest addition to the Bulk-O-Matic line of bulk storage tanks is the 12-ft.-dia. galvanized-steel model. Equipped with center draw-off hopper, it provides up to 80 tons of self-unloading bulk storage.

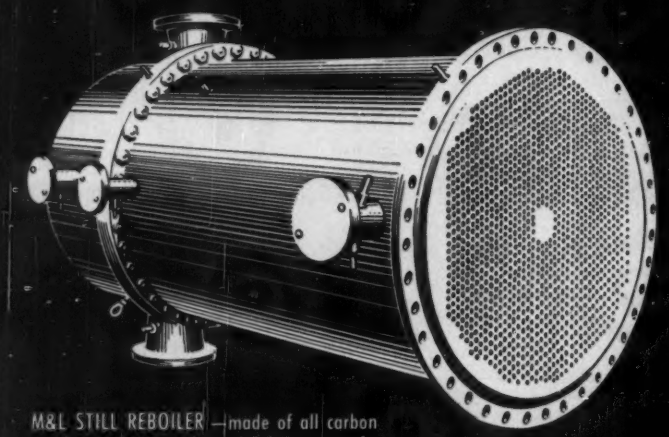
Prefabricated, the bolted tank comes ready for assembly— no special tools are required. The Bulk-O-Matic line is claimed to provide quality storage at one-

Federated Zinc Dust 97% minimum metallic, zinc 97% thru 325 mesh. Prompt shipment from Asarco, America's leading producer. Complete research and engineering assistance. Now being used as a reducing agent, precipitating agent, purifier, catalyst, polymerizing agent, in rust-resistant paints, bleaches, pyrotechnics, soot-removal, Sherardizing, pipe thread compounds. For experimental half-pint sample, write American Smelting and Refining Company, Federated Metals Division, 120 Broadway, New York 5, New York.

FEDERATED METALS DIVISION OF



MANNING & LEWIS



M&L STILL REBOILER—made of all carbon steel to A.S.M.E. code and T.E.M.A. specifications. (Design temp. 450°F, weight 9500 lbs., Shell—44" dia., 8'9" length, 1-1/16" thick, 1500 steel tubes—¾" O.D. x 14 B.W.G.)

Many years of experience have given us an unusually thorough knowledge of the appropriateness, adaptability and qualities of fabrication of a wide variety of metals. This accumulated knowledge, coupled with our engineering experience and the important "extras" in fabrication, is your assurance of practical trouble-free equipment at the lowest possible cost.

It is impossible, in a field requiring such wide diversification, to illustrate, or even list all the products we have been called upon to supply. An excellent case in point, however, is the Reboiler above. In its fabrication, X-Raying was performed to assure perfect welds. This example is typical of the "extra" care you can expect and get from Manning & Lewis.

Call on us the next time you need equipment. We are fully qualified to design and fabricate to all codes.

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ENGINEERING COMPANY

Dept. A, 28-42 Ogden Street, Newark, New Jersey

DESIGNERS & MANUFACTURERS OF QUALITY HEAT EXCHANGE EQUIPMENT

half the cost of welded tanks. Each 12-ft. model comes equipped with a flow-controlling slide valve; pneumatic loading facilities are optional.—**Butler Mfg. Co., 7400 East 13th St., Kansas City 26, Mo.** 173A



Radiation Meter

Eliminates need for two separate instruments.

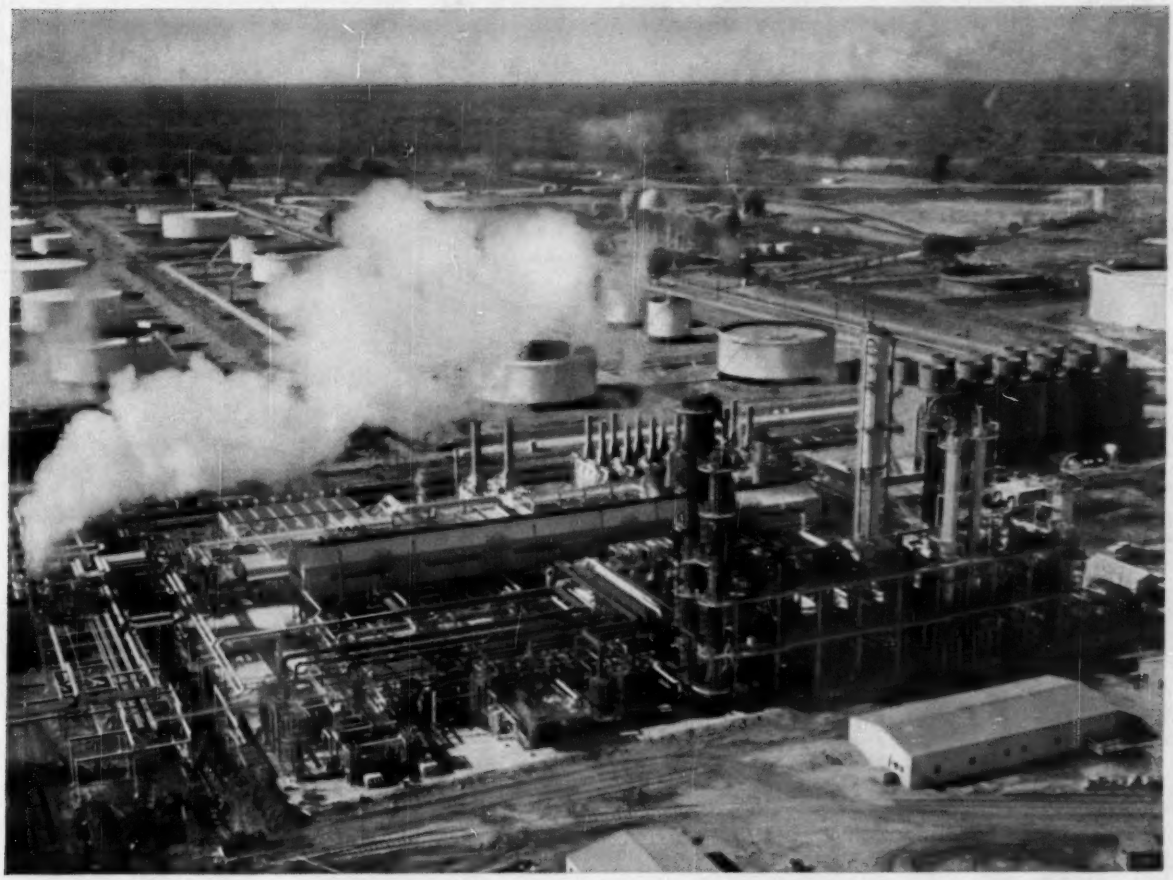
Sensistive to both gamma and beta radiation, the Model GB-1 survey meter is available as a rugged, self-contained, lightweight package. Controls and meter scale are easily accessible and legible. A mercury battery provides 300 hr. of continuous operation, one year intermittent.

The log-linear meter has three survey ranges—the 0-1 mr./hr. linear scale and two 3-decade ranges for 0.5-500 mr./hr. and 0.5-500 R/hr. Energy dependence is flat to within 10% from 80 kv. to 1.2 mev.—**Riggs Nucleonics Corp., 717 North Victory Blvd., Burbank, Calif.** 174A

Gas Flowmeter

Reads mass flow directly; temperature compensated.

A new flowmeter provides direct reading of gas mass flow, independent of temperature and pressure variations. Calibrated directly in mg./min., the meters utilize a heated thermopile



Producing for today with a design for tomorrow

At Sweeny, Texas, one of the world's largest ethylene plants was recently completed for Phillips Chemical Company. It was designed and constructed by Stone & Webster Engineering Corporation.

With a current annual capacity of 180 million pounds of high purity ethylene, the plant design permits ready expansion of production to 290 million pounds per year. Flexibility provisions in the design allow the installation of the additional facilities required for this capacity increase without interrupting plant operations.

Many companies in many different industries throughout the world find this ability to "design for tomorrow" one of Stone & Webster's most valuable engineering contributions. Whatever the scope or complexity of your engineering problem, you will find Stone & Webster's skill and experience most profitable . . . from blueprint to on-schedule project completion.

Write or call us for information as to how our experience can be of assistance to you.

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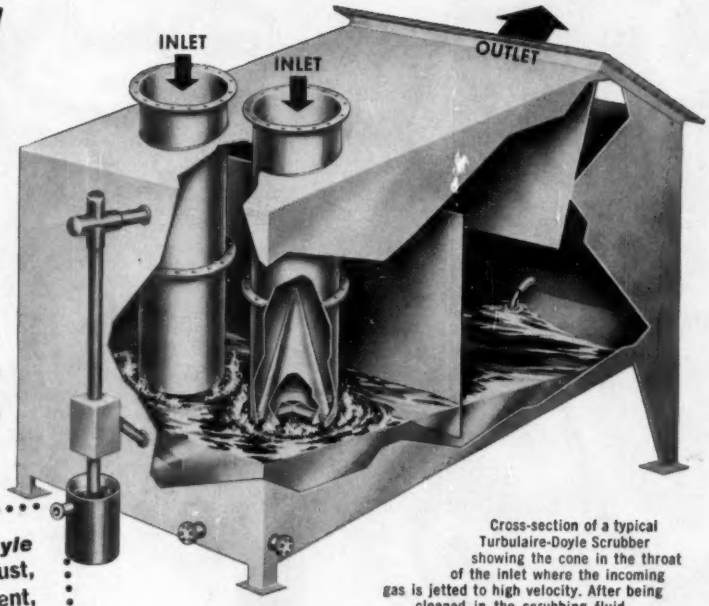
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NEW

Savings and efficiencies in Gas Scrubber Applications

with the

TURBULAIRE-DOYLE SCRUBBER



Cross-section of a typical Turbulaire-Doyle Scrubber showing the cone in the throat of the inlet where the incoming gas is jetted to high velocity. After being cleaned in the scrubbing fluid, the gas passes over spray eliminator baffles before it is discharged. Collected material is carried away by the circulating scrubbing liquid—is recovered as a liquid concentrate or slurry.

With addition of the Turbulaire-Doyle Scrubber to its line of advanced dust, fume and fly ash collection equipment, there is no industrial gas cleaning problem that Western Precipitation cannot handle with equipment of its own design. This assures your dust and fume control problem receiving the benefit of the industry's most complete "know-how" in all phases of gas cleaning operations.

The Turbulaire-Doyle Scrubber — a development of The Consolidated Mining and Smelting Company of Canada Limited and widely used in its own diversified operations—is now made available to industry by Western Precipitation Corporation under a license arrangement with Cominco.

Actual plant records, compiled over long periods of service, show the Turbulaire-Doyle Scrubber to be unique among commercially-available scrubbers in the multiple advantages it offers...

★ *High Collection Efficiencies* — generally 97% to 99%!

★ *Fine Particle Collection* — including those in the fume range!

★ *Low Liquid-to-Gas Ratio* — only 1 to 5 GPM per 1000 CFM!

★ *Wide Application Flexibility* — readily adaptable to various types of corrosion-resistant materials!

SIMPLE, TROUBLE-FREE DESIGN

The Turbulaire-Doyle Scrubber impinges dust-laden gas at high velocity into a bath of scrubbing liquid. The high velocity forces the gas and dust particles to penetrate deeply into the liquid for complete wetting and cleansing. A cone in the gas inlet nozzle, just above the surface of the scrubbing bath, provides the jetting action that assures outstanding performance from this unit. *There are no moving parts, nothing to require frequent maintenance!*

If you have dust or fume control problems where scrubber types of collectors are applicable, it will pay you to investigate the *years-ahead* advantages of the Turbulaire-Doyle Scrubber. Write, wire or phone the Western Precipitation office nearest you for further details.

TYPICAL APPLICATIONS INCLUDE:

Cleaning Gases from sintering machines, blast furnaces, roasters, dryers, calciners, crushers, screens, ventilators etc., in a wide range of chemical, metallurgical, rock products, and waste disposal operations.

Cooling and Humidifying Gases from fertilizer, acid, carbonating, smelting, alloying, and reclaiming operations where cool, moist gases are necessary for proper processing.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
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Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

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Precipitation Company of Canada Ltd., 8285 Mountain Sights Avenue, Montreal 9

within a flow tube as measuring element. Element installs directly in flow line or, for large lines, within a bypass.

Available in several sizes, the meters cover a flow range from 0 to 10,000 mg./min. Highest accuracy and maximum readability in the 50-1,000 mg./min. range.—**Hastings-Raydist, Inc., Hampton, Va.** 174B

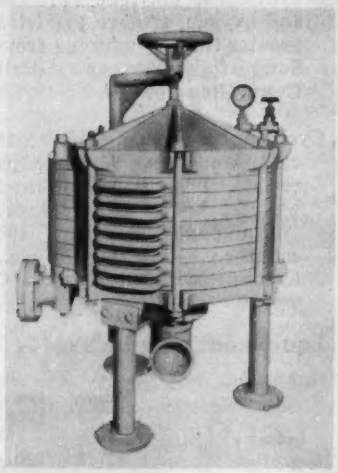


Plate Filter

Tankless model results in cost and space savings.

Filter-plate design of the new Model TL horizontal plate filter eliminates the necessity for a tank—the plates serve as a filter unit within themselves. Tank elimination cuts original and operational costs, as well as floor space requirements.

Leakage is prevented by tie-rod construction, as opposed to single-bolt clamping. In addition, plastic-impregnated edges on cloth and other media effectively seal the plate rims. Available in capacities to 396 sq. ft. of filtering area, Model TL operates at standard pressures of 150 psi.—**Sparkler Mfg. Co., Mundelein, Ill.** 177A

BRIEFS

Check valve for oil process lines features insulation for protection from electrolytic action. The top-entry, double-union valve, which operates under pressures to 500 psi., is



AVONDALE

builder of dual capacity tank barges for the petrochemical industry

The chemical tank barge shown above, equipped with six tanks and a 10,000 barrel capacity, holds the largest tanks ever designed and built by Avondale. The tanks are specially fitted and valved to hold propane and ammonia in various combinations or separately. Each tank measures 94′0″ by 12′0″, with a working pressure of 260 psi. Avondale's creative engineering and large capacity tank fabricating facilities provide you with the right source to meet your petrochemical requirements. *Write for our illustrated brochure, Marine Construction, Vol. 2.*



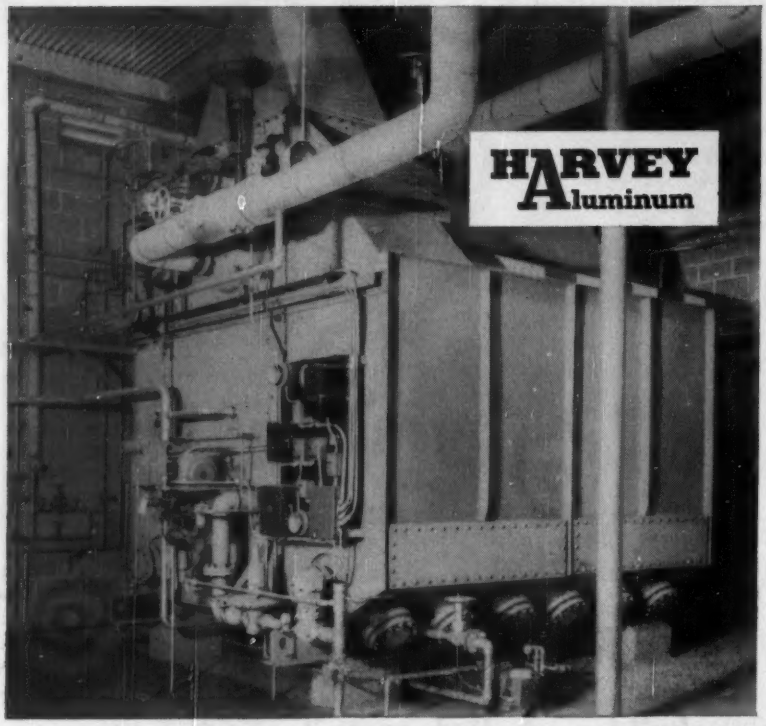
AVONDALE

MARINE WAYS, INC.

VERSATILE BUILDER ON THE MISSISSIPPI

P. O. BOX 1030 • PHONE UN 6-4561 • NEW ORLEANS 8, U. S. A.

Producing high temperatures at low pressure



Union Packaged Vaporizer plays key role in aluminum reduction

Harvey Aluminum, world's largest independent producer of wrought aluminum mill products, selected this Union Packaged Vaporizer to deliver high temperatures and low pressure for its aluminum reduction process.

Featuring compact 3-drum design, extremely large heating surface, and completely automatic controls the Union Vaporizer is installed in Harvey's smelting plant which produces aluminum pig, ingot and billet. It serves four continuous mixers turning out carbon electrode paste for the reduction cells. Summing up the reasons for its choice, Harvey Aluminum says: "Investigation of similar Union installations indicated the equipment to be well designed and built. Production people were well pleased."

Throughout industry, Union Vaporizers handle a wide variety of process requirements, providing a broad range of accurately controlled temperatures at low pressure. Both packaged and field erected units can be outfitted for heating with oil, gas, waste heat or special fuel in outdoor and indoor installations.

Union also produces a complete line of Process Heating Equipment for use with Dowtherm "A" and "E", Para-Cymene, Anisole, Aroclor #1248 and Heat Transfer Oil, either convection, or forced circulation.

UNION BULLETIN DV
will give you the whole story. Write for your copy.



UNION IRON WORKS
Erie, Pennsylvania

NEW EQUIPMENT . . .

engineered for 2-in. lines.—**Clayton Mark & Co., Evanston, Ill.** 177B

PVC pipe flange line now available consists of threaded, socket, blind and reducing types in both 6- and 8-in. sizes. Normal or high-impact service. — **Luzerne Rubber Co., Trenton, N. J.** 178A

Filters for exotic liquids, including hydrogen peroxide, hydrazine, ethylene chloride and oxygen, remove particles greater than 40 microns from flows to 5,000 gpm.—**Pall Corp., Glen Cove, N. Y.** 178B

Cyclone tubes made of white cast iron have such high resistance to corrosion and wear that manufacturer guarantees tube life of 100 months. — **Aerotec Corp., Greenwich, Conn.** 178C

Equipment Cost Indexes . . .

	March 1958	June 1958
Industry		
Avg. of all	231.2	230.7
Process Industries		
Cement mfg	222.9	222.2
Chemical	232.4	231.7
Clay products	216.6	216.0
Glass mfg	219.4	218.8
Paint mfg	223.8	223.1
Paper mfg	223.9	223.3
Petroleum ind	228.6	227.9
Rubber ind	231.4	230.7
Process ind. avg	228.8	228.2
Related Industries		
Elec. power equip	234.2	234.3
Mining, milling	233.8	233.1
Refrigerating	261.5	260.7
Steam power	219.5	218.4

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

For More Information . . .

about any item in this department, circle its code number on the

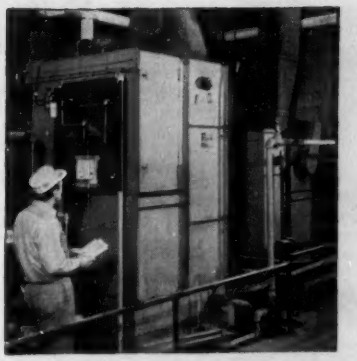
Reader Service

postcard (p. 193)

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity

Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent



This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because... the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because... you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

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Underwater for three days during a recent New England flood,* two Sel-Rex Rectifiers operated perfectly after a superficial cleaning. Now we don't recommend running Sel-Rex Rectifiers underwater—but this incident typifies the rugged dependability you get with all Sel-Rex Metallic Power Rectifier Equipment.

Send for FREE "GUIDE" to industrial rectifier equipment.

*We do make a model for underwater operation.

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Representatives in Principal Cities
"Complete Semiconductor Power Conversion Systems for any AC to DC application."

FOR CORROSION-RESISTANT COATINGS

PLASITE®

PROVEN IN THE PROCESS INDUSTRIES

- STEEL TANK LINING
- CONCRETE TANK LINING
- PROTECTION OF STRUCTURAL STEEL, FUME DUCTS AND EQUIPMENT
- CONCRETE FLOORS
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PLASITE Protective Coatings are formulated with a combination of high resistant resins to achieve highest possible chemical resistance.

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COLD SET COATINGS

HEAVY BUILD using standard spray or brush methods.
WIDE CHEMICAL RESISTANCE to acids, caustic solvents, salts, de-ionized water, and aqueous solutions.
HIGH TEMPERATURE RESISTANCE not affected by thermal shock.
AIR DRY field applications.
EXCELLENT BOND — No Primers on white metal blasted surface.

HIGH BAKE COATINGS

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- PLASTICISED PHENOLICS

CAULKING COMPOUNDS
PRIMERS
HIGH RESISTANT — Quick drying.
HEAT RESISTANT COATINGS
Temperature to 1200°F.



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Dow Corning SILICONE DEFOAMER!

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1 oz kills foam in:

250,000 lb molasses, vat dye solution, trioxide pickling solution, tall oil

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62,500 lb soft drinks, 70% caustic liquor, black liquor, sulfuric acid pickling bath, hexane-soya oil extract

FREE SAMPLE! Make your own test. Return coupon below for generous *trial sample* of a Dow Corning SILICONE DEFOAMER. No obligation, of course.

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My foamer is
Oil system
Aqueous system
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Say It Simply, Clearly

DO aim your talk at the interest level of your audience.

DO make your opening remark go to the core of your topic.

DO give serious attention to proper audio and visual aids.

DO make it a point to stay rigidly within the time limit.

"Oral Communication of

YOU'LL want to take a close look at this little 199-page manual if you're seriously interested in becoming a more effective (and more popular) speaker. It's full of practical advice on how-to—from making

Tool Up With Statistics

APPLIED STATISTICS FOR ENGINEERS. By William Volk. McGraw-Hill Book Co., New York. 354 pages. $9.50.

Reviewed by Leon Cooper, Research and Engineering Division, Monsanto Chemical Co., St. Louis, Mo.

Here's an introductory text on what might be called the basic tools of the applied statistician. Material is assembled and presented in such a manner as to be suitable for engineers or other scientists who have little or no previous knowledge of statistics.

The book constitutes a collection of the most useful statistical techniques with many examples of how particular techniques are applied. For the most part, mathematical derivations are omitted.

First two chapters offer a 20-

BOOKSHELF

J. B. BACON

DON'T give a talk before you've practiced it carefully.

DON'T try to impress with big words or pompous phrases.

DON'T show slides that are complex or hard to read.

DON'T make your audience strain to hear you; it won't!

Technical Information"

formal scientific lectures to talking science to the man on the street. It's written by Shaeffer Pen's Chief Chemist Robert S. Casey, published by Reinhold Publishing Corp., New York. Price is $4.50.—JRC

page summary of the laws of probability and simple combinatorial notions. Following this there is a terse but adequate discussion of the three basic probability distributions — binomial, Poisson and normal. The next chapter is a presentation of the different measures of variability that statisticians have developed with some mention of their significance and use.

Next four chapters constitute the heart of the book. These are devoted to the chi-squared test, the *t* test, a very good discussion of analysis of variance, and finally a chapter on correlation and regression. This material is the actual working kit of the applied statistician, and it is presented clearly and with many excellent examples.

The following two chapters are brief discussions of sequential analysis and nonparametric statistics.

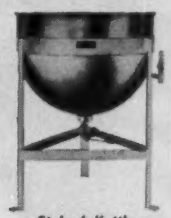
In the chapter on correlation

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For Reduced Processing Costs



Style CW Kettle
⅔ Jacketed, 80 to 300 gal.



Style A Kettle
⅔ Jacketed, 5 to 500 gal.



Style C Kettle ⅔ Jacketed, 5 to 100 gal.



Pressure Kettle
⅔ Jacketed, 40 to 200 gal.



Style B Kettle
Full Jacketed, 10 to 300 gal.

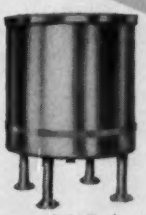


Style CW3T Kettle
with Center-Line Scraper Agitator, 80 to 300 gal.

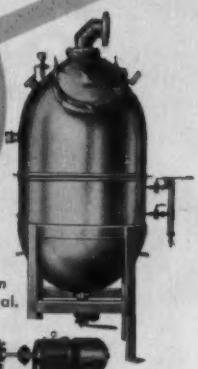
KETTLES

TANKS

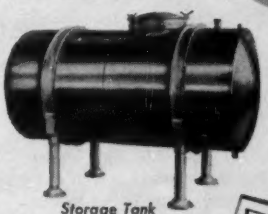
PANS



Pulp Tank
500 to 2,000 gal.



Vacuum Pan
30 to 500 gal.



Storage Tank
100 to 5,000 gal.



Quick Cooling Pan
50 to 200 gal.

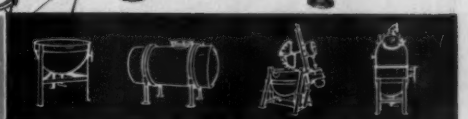
Write for bulletins on any of the products illustrated.



LEE

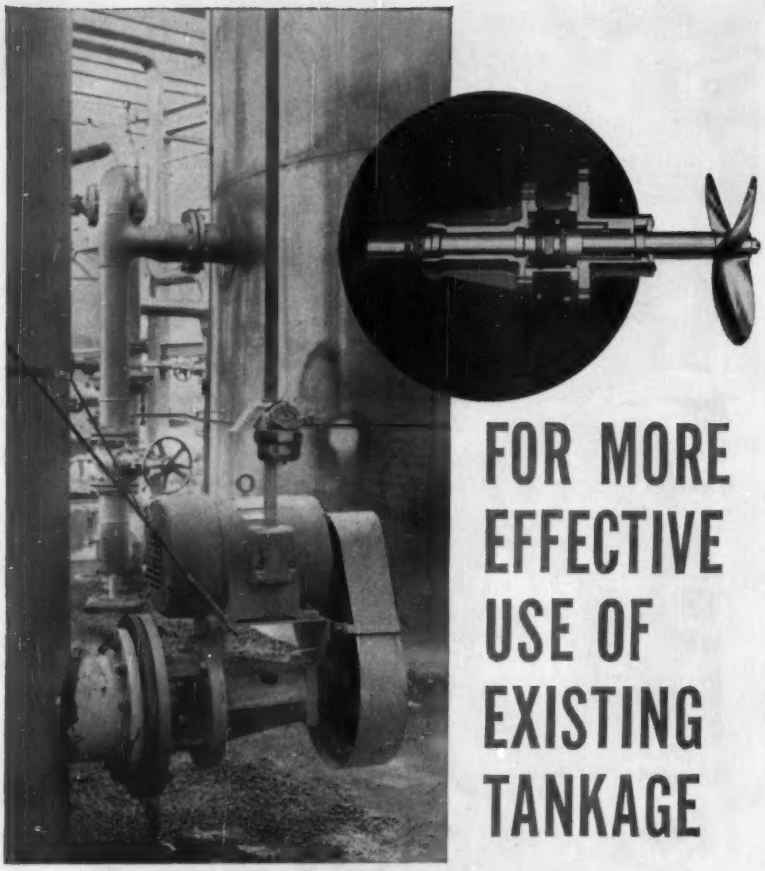
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and regression, there is no mention of the existence and growing importance of nonlinear regression, but this is a minor point.

The book can be recommended as a clear, forthright presentation of the basic statistical techniques for beginners in the field.

An Expanded Work

ION EXCHANGE RESINS, 2nd ed. By Robert Kunin. John Wiley & Sons, Inc., New York. 466 pages. $11.

Reviewed by F. C. Nachod, Sterling-Winthrop Research Institute, Rensselaer, N. Y.

This is the second edition of a text which originally appeared in 1950 with R. J. Myers as co-author.

The phenomenal growth of ion exchange as a unit operation is reflected in the fact that the present edition is more than twice as large as the first and that the chapters have increased in number from 12 to 17. Notable additions comprise discussions on the stability of ion exchange resins, and on design and economics of ion exchange units. The original work has been expanded, and 1,170 references to the literature are appended.

The only possible criticism one might level against this book is that it treats resins manufactured only by the corporation with which the writer is associated, so that the unsophisticated reader might not be aware that other materials, as well as manufacturers, exist in this highly competitive field.

Advances Against Pests

ADVANCES IN PEST CONTROL RESEARCH, Vol. I. Edited by Robert L. Metcalf. Interscience Publishers, New York. 514 pages. $11.

Reviewed by E. D. Goldsmith, Research Coordinator, New York University.

Most recent advances in the multifaceted applied science of

pest control are brought together in this volume. Emphasis has been placed on the fundamental aspects by specialists. The reviews are not only comprehensive but are also critical evaluations of new developments.

Titles of the ten chapters reveal the scope of the volume. They are: Control of Health Hazards Associated with the Use of Pesticides; Chemistry and Mode of Action of Herbicides; Use of Radioisotopes in Pesticide Research; Chemistry and Action of Organic Phosphorus Insecticides; Mechanism of Fungitoxicity; Recent Advances in Control of Soil Fungi; Repellents for Biting Arthropods; Status of Systemic Insecticides in Pest Control Practices; Chemical Analysis of Pesticide Residues, and Bioassay of Pesticide Residues. The bibliographies included in the individual accounts are complete and up to date.

The series, of which this is Volume I, should prove to be a valuable addition to the literature of pest control.

BRIEFLY NOTED

NONDESTRUCTIVE TESTS IN THE FIELD OF NUCLEAR ENERGY. *420 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.* $10. Report of symposium held in Chicago, April, 1957; contains papers on testing of reactor components, testing of fuel assemblies and other topics, discusses eddy-current testing, radiography, ultrasonic testing, X-ray diffraction and photograpic methods.

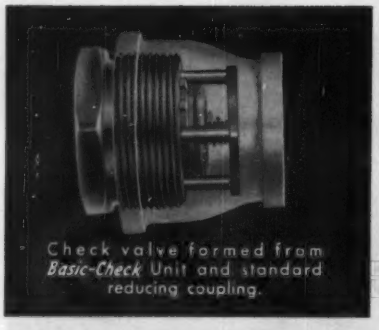
SUPPLEMENTARY LIST OF PUBLICATIONS OF THE NATIONAL BUREAU OF STANDARDS, July 1, 1947, to June 30, 1957. *873 pp. Superintendant of Documents, U. S. Government Printing Office, Washington 25, D. C.* $1.50. Lists publications in applied mathematics series, building materials and structures reports, circulars, handbooks and research papers.

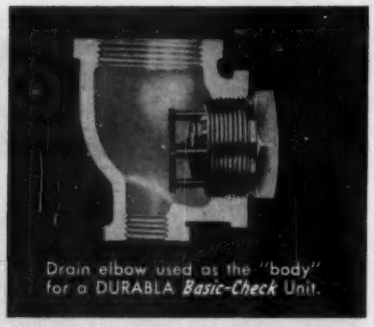
MORE NEW BOOKS

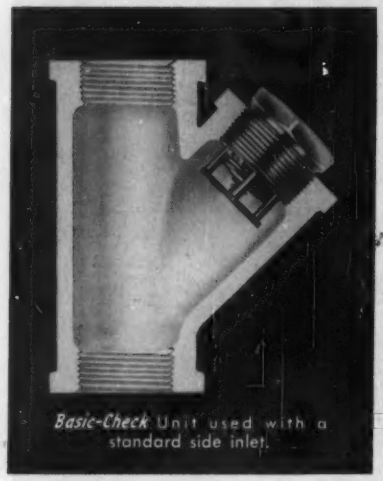
THE PROPERTIES OF LIQUIDS AND GASES. By R. C. Reid and T. K. Sherwood. McGraw-Hill. $10.

THE SCIENCE OF HIGH EXPLOSIVES. By Melvin A. Cook. Reinhold. $22.50.




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Drain elbow used as the "body" for a DURABLA *Basic-Check* Unit.


Basic-Check Unit used with a standard side inlet.


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PEOPLE . . .

LETTERS:

Friction in Smooth Pipes

Sir:

The article, "Equation Gives Friction Factor," by Benjamin Miller (Dec. 1957, pp. 253-4), makes extensive use of data published by the Bureau of Mines in 1956.

Mr. Miller has made a worthwhile contribution to the understanding of the flow of fluids in pipe, and his earlier equation which you published in 1937, relating transmission factor and Reynolds number for turbulent flow, was confirmed by the Bureau's work on flow in superfinished pipe. However, we believe that Mr. Miller's word of caution about use of such data needs to be emphasized.

The smooth pipe used by the Bureau of Mines, to which Mr. Miller refers, had a specially prepared internal surface. It was honed with wood laps and suitable grinding compounds to a "mirror-smooth" finish. Particular care was taken to keep the cross section circular and the diameter constant. A test of the roughness by profilometer measurement showed a maximum roughness of 15 microinches in a length of 122 ft.

Preparation of the internal surface required several months of work by the Naval Gun Factory. There is a great difference between this superfinished pipe and that used in commercial pipelines.

Almost any commercial pipe, even if the internal surface has an appreciable roughness, will have the characteristics of an extremely smooth pipe at low Reynolds numbers. In this region, transmission factor $(1/f)^{0.5}$ is a function of Reynolds number. At higher Reynolds numbers, transmission factor is influenced by both surface roughness and Reynolds number. At still higher Reynolds numbers the transmission factor is a function of internal roughness alone.

In a commercial pipe with a diameter of 30 in. and a wall thickness of $\frac{3}{4}$ in., transition

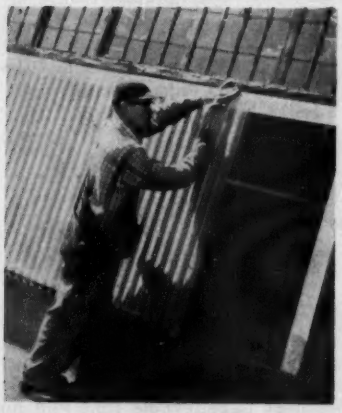
PRO & CON

C. H. CHILTON

from low to intermediate conditions occurs at a Reynolds number of about 2.7 million, and the second transition occurs at 28 million.

Use of the smooth pipe equation for design at a Reynolds number of 40 million would result in an actual capacity about 86% of the intended design capacity. Internal roughness must be considered in pipeline design.

J. S. MILLER
Bureau of Mines
Bartlesville, Okla.



Plastics vs. Fire Hazards

Sir:

Your Corrosion Forum article, "Plastic Panel Coverings Handle Tough Plant Conditions" (May 5, pp. 152-6), appears to have oversimplified the section on fire hazards.

Several industry and insurance associations are interested in the subject of plastics in construction. It is hoped that research work now under way will eventually lead to adequate classification of various plastic construction materials so that they can be fitted into the proper place in modern performance-type construction codes.

There are differences of opinion today, however, as to proper use of plastics. For example, unlimited use of corrugated reinforced plastic sheets, even in sprinklered buildings, can result in having the buildings rated as combustible. This would lead to



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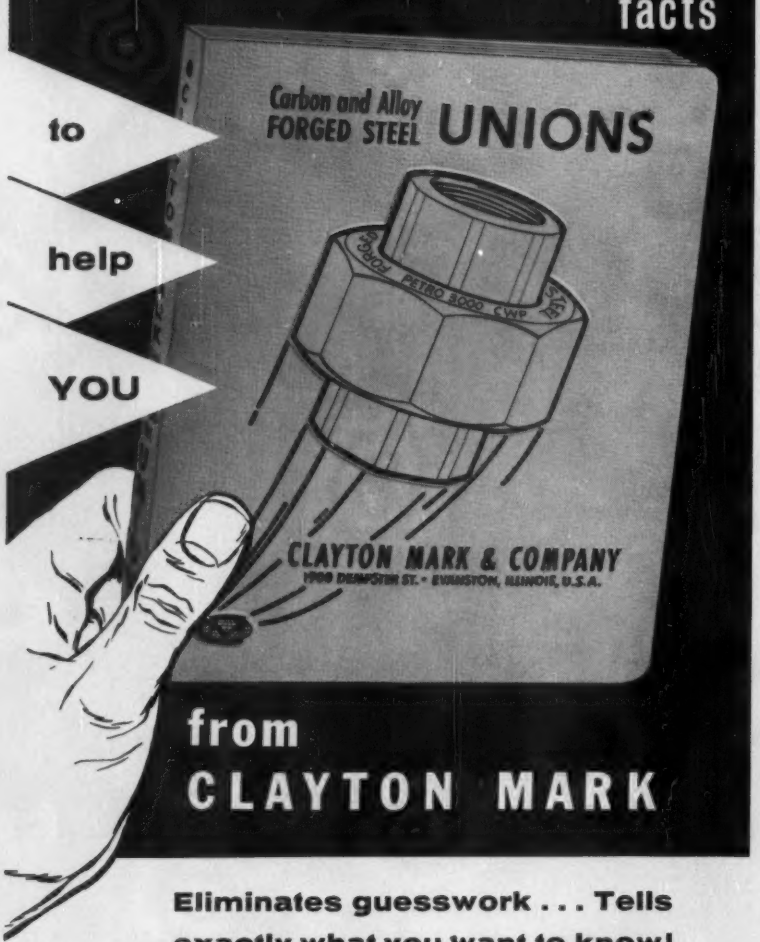
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an insurance rate higher than if the construction materials were corrugated asbestos or sheet metal. In some rating jurisdictions, covering of more than 10% of a wall or roof area with corrugated plastic can result in a rating charge.

Use of large quantities of plastics in construction may also require provision of special smoke-venting facilities in order to permit efficient fire fighting from within the building.

Many plastics use partially chlorinated or fluorinated intermediates in their manufacture. Their products of decomposition are extremely corrosive, with the result that their involvement in a relatively small fire could cause major damage to precision machine parts, electrical contacts, etc. Furthermore, fumes from such plastics may be quite toxic under fire conditions so that special fire-fighting techniques may be required.

W. H. DOYLE
Factory Insurance Assn.
Hartford, Conn.

Professional vs. Employee

Sir:

In reference to Mr. Malmsten's letter (*Chem. Eng.*, June 16, p. 210) and your pontifications which were appended to it, it is almost unbelievable that you do not understand what Malmsten was trying to say. He was too much on the defensive in his letter, but the point of his complaint—that you changed his signature from that of an individual to that of agent of a corporation—is a valid one.

The word "unethical" is too mild to describe the dropping of the P.E. from his signature by the editor of a magazine pretending to serve the chemical engineering profession. I believe that if this was done without his foreknowledge, he would have cause for legal action for any damage to his employment status.

There may be the excuse of ignorance of the meaning of P.E. in a lay journal, but you know better. Try leaving M.D. off sometime.

It would be futile, I'm sure, to try to argue that an employee is also a human individual, with

individual rights, forgetting professional responsibilities. But I would like to suggest that Mr. C. H. Chilton do some objective reflecting on that proposition.

RALPH J. WINTERS

Nutley, N. J.

▶ *We believe that an engineer's current professional activities (including place of employment, if any) are more germane to his comments and opinions today than an academic degree or a professional license (possibly obtained without examination under a grandfather clause) granted years ago. We follow this same policy in the bylines which identify authors of our feature articles. So do the editors of other magazines serving the chemical engineering profession.*

As to the individual rights of professional employees, we suggest that Mr. Winters read our You & Your Job feature on trade secrets and employment contracts (July 28, pp. 127-130) as just one example of our "objective reflecting." —ED.

Pro: Government Service

Sir:

The cover of your May 5 issue sure hit a point with me. I reported for active duty as 2nd Lt. Army Ordnance at Aberdeen Proving Grounds on the same date, May 5.

JAMES C. BARME

Aberdeen, Md.

Honoring a Pioneer

Sir:

Those of us in the Gulf Coast area who knew, worked with and loved V. A. Kalichevsky are attempting to set up a student scholarship fund in his honor. Inasmuch as Dr. "Kali" had written many articles and had a host of friends throughout the world, we believe that others who had come in contact with him might be interested in helping build this fund.

The fund is being handled by N. H. Kelton, dean of student life at Lamar State College of Technology, 4400 Port Arthur Road, Beaumont, Tex. Contributions should be made out to "The V. A. Kalichevsky Memorial Fund." It is our understanding that any donations made are income-tax deductible.

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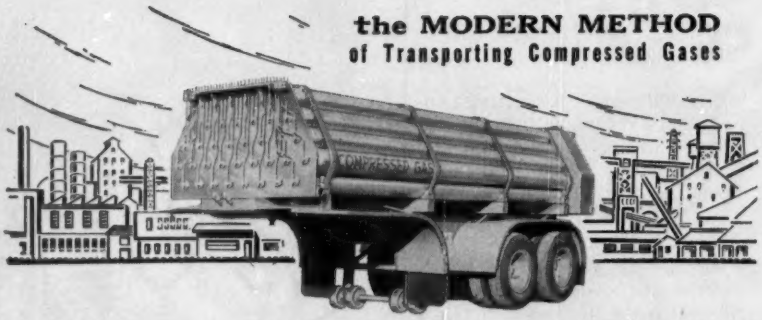
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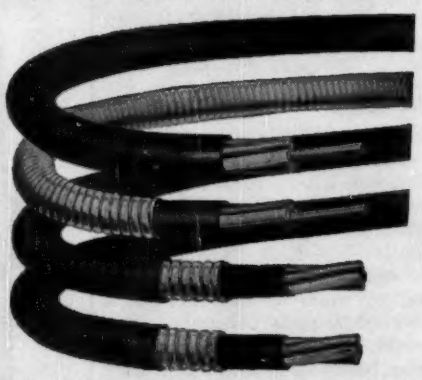
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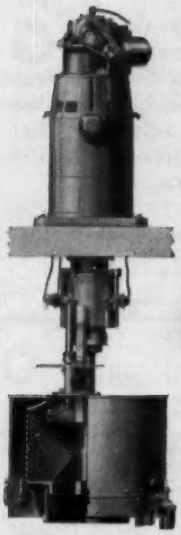
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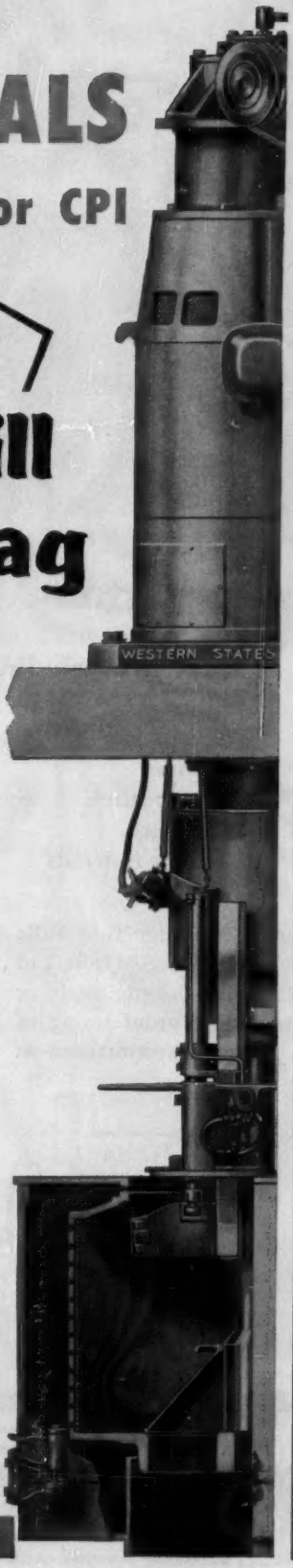
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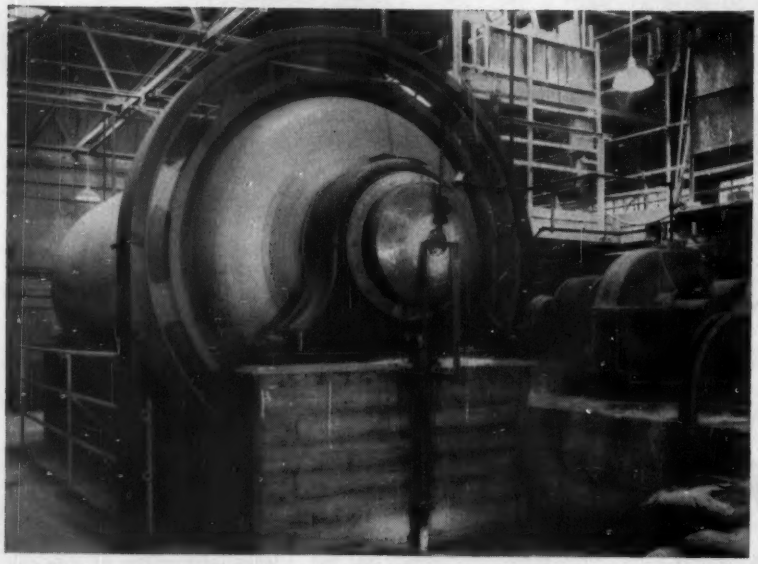
Help yourself in this supermarket of ideas. All you need is a pencil and a postcard (p. 193).

Here's what's available: More information on any advertised product or service; Latest technical literature (p. 190); Additional details on new chemicals and equipment described in this issue (pp. 94-100).

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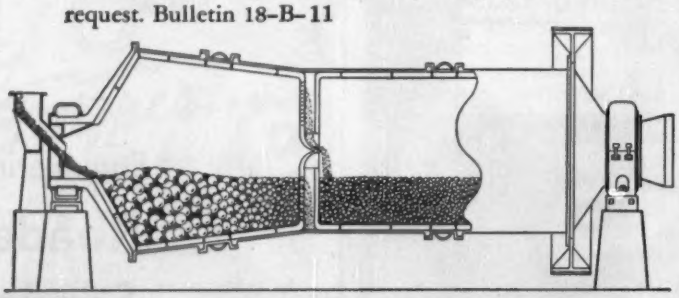
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TECHNICAL

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Chemicals

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77 *Atlas Powder Co, Chem. Div.

Caustic Soda Anhydrous.....Flo chilled to flow free and easy in automatic machinery any time of year. You will find it's the same price as ordinary caustic.
185 *Wyandotte Chemicals Corp.

Antifoams.....Information sheet covers new antiforam additive designed specifically for pulp and paper mill operations. How to use it, how much to use .
190A Hodag Chemical Corp.

Antioxidants.....12 p. brochure describes use to retard development of rancidity in edible animal fats with emphasis on company's Tenox products.
190B Eastman Chemical Products

Agricultural Chemicals.....Bulletin 3, 4 p., lists prices of analyses of insecticides, fungicides, herbicides, fertilizers. Prices for sampling quoted on request.
190c Crippen & Erlich Laboratories

Bromine.....29 p. booklet covers characteristics, reactions, safety precautions, handling and emptying bromine shipping containers, materials & methods for handling.
190D Dow Chemical Co.

Catalysts.....An experienced technical staff will assist you in developing the best & most economical catalyst. Available in tablet, powder, granule forms etc. Booklet.
12 *Harshaw Chemical Co.

Catalyst Carriers.....Alundum low surface area catalyst carriers add speed & efficiency to many processing reactions. Excellent thermal & chemical stability.
47 *Norton Company

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Ceramics.....24 p. booklet describes company's facilities for designing and producing ceramics for specific uses. Photos show automatic pressed parts, ceramic ferrules, etc.
191A Saxonburg Ceramics

Chemicals.....Wyandotte's technical service can help you use chemicals more efficiently & economically. Send us data with the product characteristics you want.
110A-B *Wyandotte Chem. Corp.

Defoamer.....Silicone does the most effective job . . . stamp out foam. Make your own test. Write for free sample of silicone defoamer. No obligation.
180 *Dow Corning Corporation

Diatomite.....the mineral filler, Celite that adds strength . . . soaks up dirt . . . controls gloss in paints. Available in a wide range of grades.
10-11 *Johns-Manville

Dimethyl acetamide.....Data sheet described versatile chemical compound having excellent solvent properties and utility as a chemical intermediate.
191B Borden Chemical Co.

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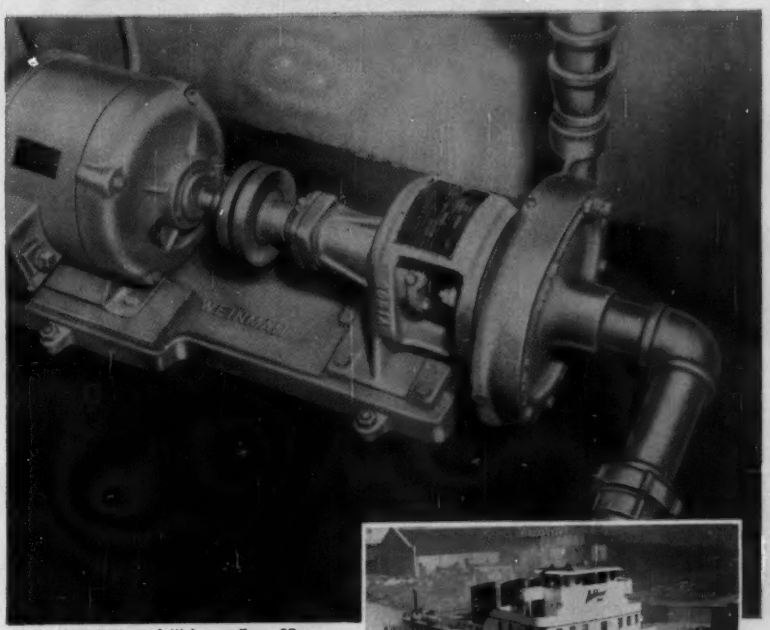
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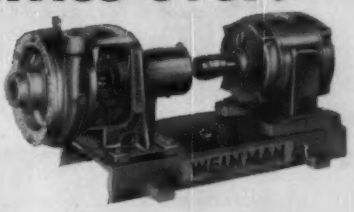
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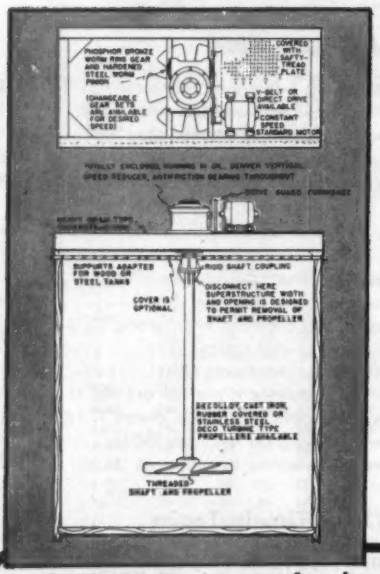
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BC221 *Sigmamotor, Inc.

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Conveyors.....Features include; low headroom, gentle conveying motion, and dynamic balancing. Smooth, one-piece troughs prevent spillage, hang-up & contamination.
43 *Carrier Conveyor Corp.

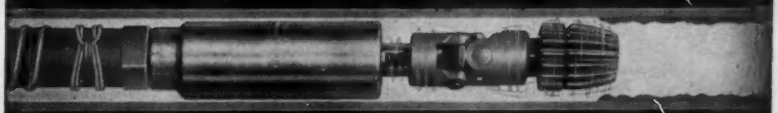
Conveyors, Vibrating.....to combine one or more screening, washing or drying operations. Catalog offers most economical & efficient conveying equipment.
R221 *Ajax Flexible Coupling Co.

Drums, Stainless Steel.....with smooth, crack-free bottoms, reinforced by special welded chimes, Hackney drums clean easier, save more on maintenance costs.
13 *Pressed Steel Tank Co.

Feeders, Airlock.....Booklet P-55 describes airlock used for low pressure dust control & high pressure pneumatic conveying. Standard, heavy duty, blow-thru.
BR199 *Prater Pulverizer Co.

* From advertisement, this issue

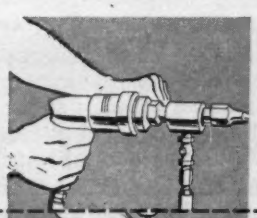
ELLIOTT
SMALL TUBE CLEANERS



types to do all jobs
quickly and effectively

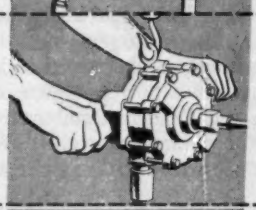
ELLIOTT 600 SERIES for small tubes—straight or curved

These air- or steam-driven motors are excellent for routing light scale in tubes with inside diameters from 5/8" to 1 3/4". Various types of cutter heads and brushes are available for specific tube cleaning requirements.



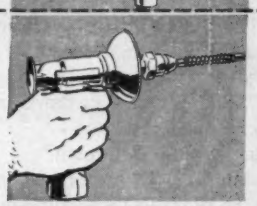
ELLIOTT 5100 SERIES lightweight cleaner for removing medium scale

Air-driven motor with trigger action for motor control, finger-action valve for water flow, built-in speed governor and oil reservoir. Two sizes.



ELLIOTT SUSPENSION SERIES for heavily scaled straight tubes

Air, steam, or electric motor drives shaft fitted with drill or brush head. Motor is suspended outside, shaft and head enter tube.



ELLIOTT JIFFY GUN for extra-fast cleaning of light accumulations

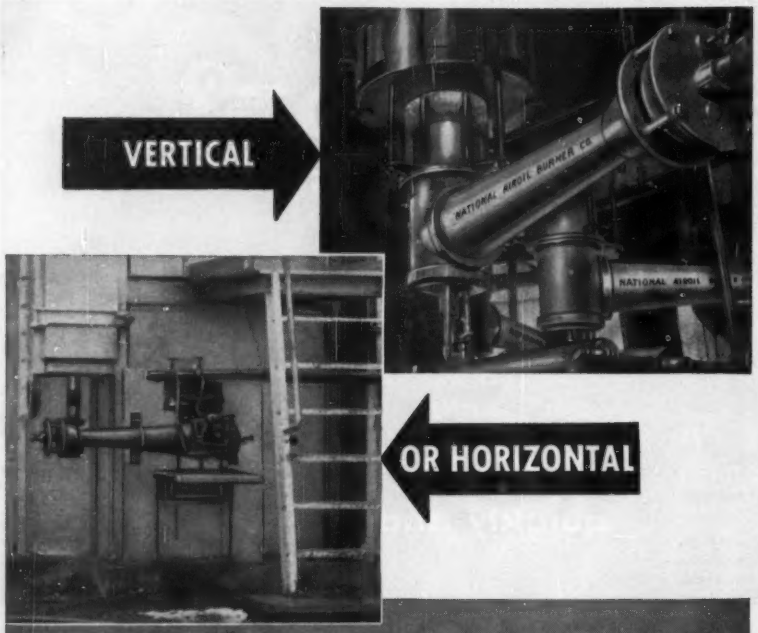
Simply insert nozzle into tube and push. Released air or water pressure shoots nylon brushes or rubber plugs through condenser or heat exchanger tubes. For tubes 1/2" to 1".

For details on Elliott tube cleaning and maintenance equipment, contact Elliott District Office or write Elliott Company, Lagonda Division, Springfield, Ohio.

Y7-1

ELLIOTT Company
Headquarters for Tube Cleaners and Expanders

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS



many more hours on stream with

NATIONAL AIROIL OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT's clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

National Airoil
BURNER COMPANY, INC.

Main Office & Factory: 1234 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS

LITERATURE . . .

Loading Arm, Barge.....saves on line handling injuries, dock clutter, lengthy hookup time, hose bursts & replacement costs. Illustrated literature available.
61 *Chiksan Co.

Tank Barges.....dual capacity for the petrochemical industry. Tank fabricating facilities provide you with the right source to meet requirements. Brochure.
177 *Avondale Marine Ways, Inc.

Tank Cars.....A standard of quality is available to industry in the tank cars & covered hoppers which are leased & sold. Repair shops keep equipment in excellent condition.
74-75 *Shippers Car Line

Tanks.....To eliminate costly corrosion maintenance problems in chemical storage & handling, tanks of Bonate plastic will fill your requirements. Write for details.
208 *Beetle Plastics Corp.

Tanks.....Storage above or below ground for gases or liquids, all types of Steel Plate Fabrication. Sales offices throughout the U. S. A. and many foreign countries.
L204 *Hammond Iron Works.

Tanks & Pressure Vessels.....Custom plate fabrication in five well equipped plants to serve the chemical processing & petroleum industries.
120 *Modern Welding Co.

Trailer, Gas Supply.....the modern method of transporting compressed gases. Feature capacities to meet your requirements & safety cylinders & devices for protection.
TR188 *Independent Engineering Co.

Heating & Cooling

Air Conditioning.....Dry & clean air at the right temperature. Compact method gives high capacity in small space. Bul. 112 & 131 give complete information.
TL179 *Niagara Blower Co.

Coil, Steam.....designed to provide uniform surface temperatures & precise temperature control, available in corrosion resistant stainless steel. Bul. M-10.
59 *Marlo Coil Co.

Condenser Tubes.....Technical service helps you get maximum life & service from your power & process equipment. Best service & advice on heat exchanger tubes.
62 *Bridgeport Brass Co.

Cooler, Horizontal-Grate.....where a short, compact unit is desired. Offers better secondary air temperature control. Write for information on a wide range of coolers.
34 *Fuller Company

Dryers.....Whether your plans include a dryer, cooler or kiln . . . let Standard-Hersey engineers help you with your processing problems. Learn results in advance.
81 *Standard Steel Corp.

Dryers, Vacuum Shelf.....enable the safe drying of heat or air-sensitive materials which must remain dormant during processing. Other type dryers available. Write.
50 *Stokes Corp.

* From advertisement, this issue

ROLOCK

SPECIALIZED WELDED HEAT AND CORROSION RESISTANT **FABRICATIONS**

for example

VACUUM RETORTS



This heavy INCONEL Vacuum Retort is one of a number of such designs being produced by ROLOCK. Approximately 2 feet in diameter by 8 feet high, it is used for high-temperature vacuum annealing.

By entrusting such work to ROLOCK, you gain the many advantages of competent engineering supervision; production personnel thoroughly experienced in the problems and materials involved; a modern plant fully equipped for inspection and testing as well as fabrication.

Rolock facilities and skills cover a wide range of work in pressure and vacuum equipment, specialized processing carriers, furnace retorts, covers and bells, trays, tanks, fabrications and assemblies in Inconel, Incoloy, Monel, the Hastelloys, and Stainless Steels. Send us an outline of your requirements.

Put your problems up to:

ROLOCK INC., 1340 KINGS HIGHWAY, FAIRFIELD, CONN.

1RL588

PRATER CAN Solve YOUR AIRLOCK FEEDER PROBLEM!

More than 2000 different Prater Airlock applications have solved processing requirements for 300 concerns. You'll find there IS a Prater Airlock for your need . . . from low pressure dust control to high pressure pneumatic conveying.



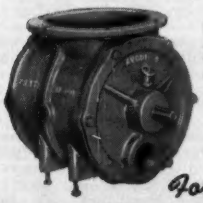
STANDARD DUTY

Principally adapted for sealing off collectors against air leakage.
Four Sizes . . . 6″, 8″, 10″ and 12″.



HEAVY DUTY

For applications involving high pressure Pneumatic Conveying or Volumetric feeding of finely ground materials.
Four Sizes . . . 6″, 8″, 10″ and 12″.



BLOW-THRU

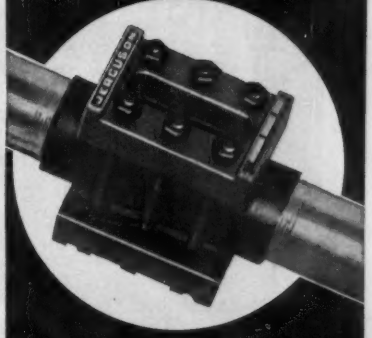
For pneumatic conveying systems handling flour or similar fine powder or granular material.
Available for 2″, 3″ or 4″ Conveying Lines.

Send for informative Booklet P-55
"How to Select a Rotary Airlock Feeder"

Foremost Builder of Rotary Airlock Feeders

PRATER PULVERIZER COMPANY
1517 SOUTH 55TH COURT • CHICAGO 50, ILLINOIS

NEW . . . Jerguson Sight Flow Indicators



easily and inexpensively installed to show movement of liquid in pipe lines

Here is a new line of Sight Flow Indicators . . . easily and inexpensively installed in any new or existing pipe line ½″ to 2″ N.P.T.

The special design of these new indicators results in a turbulence in the flow of liquid, making it easily visible. Several types of indicating vanes, installed within the chamber, may also be furnished, according to variable conditions of rate of flow and viscosity of liquid. For indication of minute flows, small Sight Flow Indicators with a rotating vertical rising ball are available.

Jerguson Sight Flow Indicators are soundly designed, carefully made, and are backed up by a company with over 40 years experience in the field. Available in Transparent and Reflex types, in a wide variety of materials and linings, and with Wedge Type Illuminators, Haveg Chambers, Non-Frosting Glasses, or other special construction.

If you have a problem of viewing the flow of liquid in a pipe line, it will pay you to investigate the new Jerguson Sight Flow Indicators today. Send us your requirements or write for Data Unit.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Adams Street, Burlington, Mass.
Offices in Major Cities
Jerguson Tress Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France



Designed with the Look of Tomorrow by Raymond Loewy Associates

NEW PARTLOW MFS TEMPERATURE CONTROL

New Looks, Convenience, Efficiency for Your Process Equipment

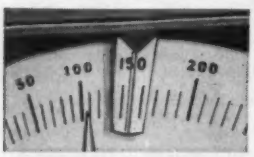
Striking as they are, good looks are only part of the story of Partlow's spectacular new control. Inside and out, the MFS is as rugged and efficient as a temperature control can be, its tough mercury-actuated element having been built to retain sensitivity and accuracy even under extreme conditions. Convenient, too! You can interchange the mercury element right out in the field... no factory adjustment is required.

The MFS comes in 10 scale ranges. Accurate within ½ of 1% of scale range, it is especially adaptable to control applications where temperature variations must be kept at a minimum; or where sudden temperature changes demand instant response.

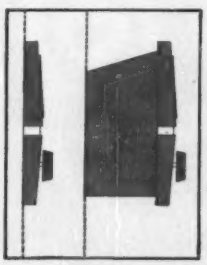
If your product or process requires close, positive temperature control within the –30° F. to 1100° F. range, you are invited to test this advanced new instrument soon. Write, wire or phone today.

THE PARTLOW CORP.
DEPT. E-858 NEW HARTFORD, N.Y.

Only in the Partlow MFS so many important innovations:



Accu-Vision Dial — Magnified pointer for closest settings. Dial calibrations, pointers and background scientifically color-contrasted for easy readability — even at a distance.



Flush or Wall Mounting — No additional brackets or hardware are required. Case is grey reinforced plastic —tough, lightweight, easy to clean, won't crack under extreme temperatures.

LOOK TO PARTLOW FOR:

Recording Controls — Indicating Controls
Non-indicating Electrical Controls
Non-indicating Mechanical Controls — Timers
Recording and Indicating Thermometers
Limit Controls — Combustion Safeguards

PARTLOW

LITERATURE . . .

Duplex Tubes.....handle corrosion problems or unusual pressure-temperature conditions in condensers & heat exchangers. Write for detailed information.
97 *American Brass Co.

Evaporators, Flash.....For helpful suggestions that will solve your fresh water problems, send for information. A complete line of evaporators for your need.
111 *Cleaver-Brooks Co.

Furnaces.....Isoflow furnaces for butadiene production, catalytic reforming & other petroleum, petrochemical & chemical processes. Unlimited in size & duty.
58 *Petro-Chem Development Co.

Heating Equipment.....send for the complete story on Grid unit heaters, blast heaters, and radiation for chemical plant use. Catalog 956 gives details.
55 *D. J. Murray Mfg. Co.

Heat Transfer Equipment.....Platecoil units are compact & lightweight. Available in Stainless, cold Rolled Steel & other corrosion-resistant alloys. Manual P61.
66 *Platecoil Div. Tranter Man.

Insulation.....Foamglas when you need constant insulating value to protect tanks, equipment or plant structures. It has a structure of sealed glass cells. Catalog.
48 *Pittsburgh Corning Corp.

Regulator, Temperature.....to save on costly damage to products in process...or injury to personnel. Sylphon bellows assure sensitivity & extra power. Bul. D-PC.
187 *Fulton Sylphon Div.

Steam Trap.....Engineered for your light load requirements the Yarway No. 30. Other types of impulse traps for your steam trap needs outlined in bulletin.
57 *Yarnall-Waring Co.

Tandem Units.....exclusively for vertical firing, these new oil-gas combustion units retain all the features of our horizontal tandems. Bulletin 498.
198 *National Airoil Burner Co.

Thermo-Panels.....instead of obsolete & costly pipe coils up-to-date engineers are now using Dean Thermo-Panels. Bulletin #355 & Bulletin #258.
BL221 *Dean Thermo-Panel Coil Div.

Traps, Steam.....Write for "Literature Kit 2A" today & get latest bulletins for advice on production planned steam trapping. Big savings in maintenance time.
42 *Sarco Company, Inc.

Tubes. Heat Exchanger..... for longer service the tubes have a full range of copper-base alloys for every application. Give complete control of quality.
20-21 *Phelps Dodge Corp.

Vaporizer, Packaged.....produces closely controlled temperatures, can be outfitted for heating with oil, gas, waste heat. Full details covered in Bulletin "DV".
178 *Union Iron Wks.

Water Chiller.....Compact, factory-assembled unit installs anywhere in the building, without costly installation. For facts & figures write for catalog EM-213.
85 *York Corp.

* From advertisement, this issue

Instruments & Controls

Clarifier.....to soften, de-alkalize and clarify water...to remove organic matter, turbidity, color & iron, as required by specific conditions. Write for details.
R204 *Illinois Water Treatment Co.

Control, Temperature.....The MFS comes in 10 scale ranges. It is especially adaptable to control applications where temperature variations must be kept at a minimum.
200 *The Partlow Corp.

Controls, Temperature.....New catalog furnishes specifications & data on a variety of general-purpose, dual-switch, & explosion-proof temperature controls. Cat. 400
201A United Electric Controls

Controls.....Valves & Regulators are available to meet your emergency needs quickly. Complete stock of popular & standard sizes on the "supermarket" shelf at all times.
8-9 *Fisher Governor Company

Corrosion Test Cabinet.....for testing corrosion with a controlled humidity cabinet. Rust preventives are more speedily & precisely tested. Write for details on Research.
95 *Standard Oil Co.

Gauges, Pressure.....To be certain of highest sustained accuracy, dependability & durability—specify Duraguages. Rotary movement has a geared center shaft.
103 *Manning, Maxwell & Moore, Inc.

Indicators.....Sight Flow are easily & inexpensively installed to show movement of liquid in pipe lines. Available in Transparent & Reflex types.
L199 *Jerguson Gage & Valve Co.

Instruments.....The most complete line of full-sized & miniature electronic & pneumatic instruments on the market. Solve problems in recording & indication.
110 *Bristol Company

Instruments, Nuclear.....Three 2 p. bulletins cover firm's Model DZ41 Gamma Ray Spectrometer, DZ15 Single-Channel Pulse Height Analyzer, DZ4 Fast-Slow Coincidence Circuit.
201B Borg-Warner Corp.

Instruments.....Hermetic sealing characterizes RMC's thermometers. Locks out moisture, cannot be affected by bimetal freeze-up. Liquid level gauges also offered.
105 *Rochester Mfg. Co.

Instruments, Control.....Choose from four controller types...that include magnetic modulation. Get the facts on their proved performance & installation.
172 *Barber-Colman Co.

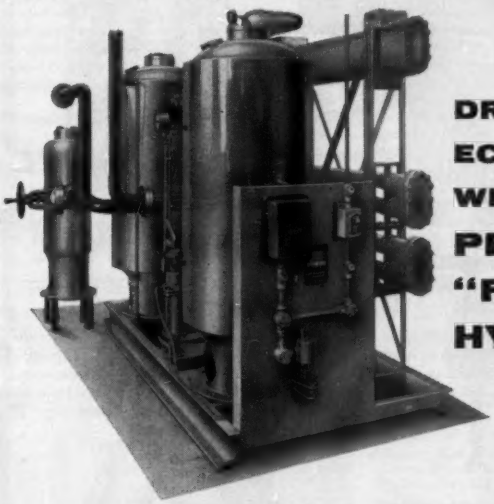
Instruments, Pneumatic.....Tel-O-Set miniature instruments accurately record, indicate, & control process variables. For complete information. Catalog C 100-1a.
18-19 *Minneapolis-Honeywell

Rectifier Equipment.....custom engineered rectification in Semiconductor Power Conversion Equipment & Systems. Flexible designs to meet specific needs. "Guide".
BL179 *Sel-Rex Corp.

* From advertisement, this issue



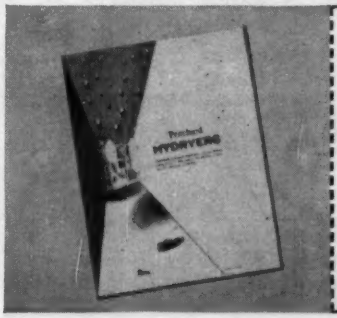
IS WET GAS OR AIR SHUTTING DOWN YOUR EQUIPMENT?



DRY IT ECONOMICALLY WITH PRITCHARD "PACKAGED" HYDRYERS

Here's the economical way to prevent pressure drops, ice formation and line blockage due to moisture in compressed air or process gases. Pritchard Hydryer continuously removes moisture from main gas stream – reduces dew points as low as −100°F. Operates at full line pressure. There's no wasted gas, no purging. No blower or moving parts to cause maintenance problems. Available as a packaged unit for faster delivery, more convenient ordering and factory-quality fabrication. Simple installation.

MAIL COUPON FOR FACT-FILLED HYDRYER BULLETIN



J. F. PRITCHARD & CO.
OF CALIFORNIA
Dept. 107, 4625 Roanoke Parkway
Kansas City 12, Missouri
Please send Hydryer Bulletin 16.0.081

Name .....
Firm .....
Address .....
City ..... Zone ..... State .....

We Sell Filtration

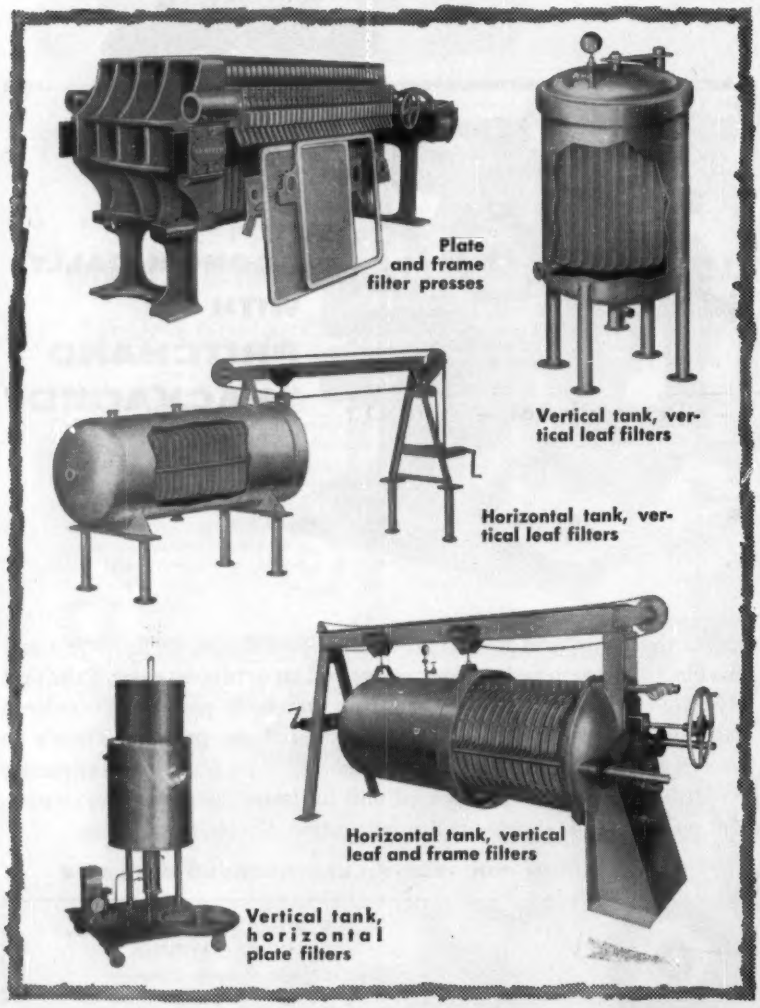
NOT THE FILTER

At Shriver's we recommend the filter that's *right* for the specific processing conditions. This is done without prejudice or bias.

Of course, we design and manufacture an extensive line of pressure filters, suitable for a large majority of applications, but if our careful study of your filtration problem shows you need a vacuum filter or a pressure filter we do not manufacture, we tell you so frankly. Our aim: your satisfaction.

It's that simple, and has been paying off in customer goodwill for many years. We hope to continue meriting industry's confidence.

Literature on Shriver filtration equipment shown here will be gladly sent on request.



T. SHRIVER & COMPANY, INC.

802 HAMILTON STREET • HARRISON, N. J.

SALES REPRESENTATIVES IN: Chicago, Ill.—Decatur, Ga.—Houston, Tex.—Livonia, Mich. St. Louis, Mo.—San Francisco, Cal.—Montreal, Que.—Toronto, Ont.

FILTER PRESSES • VERTICAL LEAF FILTERS • FILTER MEDIA
HORIZONTAL PLATE FILTERS • CONTINUOUS THICKENERS
SLAB FORMERS • DIAPHRAGM PUMPS • ELECTROLYTIC CELLS

LITERATURE . . .

Titrators.....32 p. booklet, "Scientific Apparatus & Methods," Vol. 10, No. 2, describes a new automatic & multipurpose titrator. Also notes company's latest catalog revisions.
202A E. H. Sargent & Co.

Transmitter.....The type 13A integral orifice transmitter gives you, not only new high accuracy in measurement, but also accurate remote indicating & recording.
107 *The Foxboro Co.

Pipe, Fittings, Valves

Fittings, Stainless Steel.....special non-standard fittings furnished to order. Feature sharp clean threads; wide reinforced bands, & uniform wall thickness. Bulletin.
183 *Camco Fittings, Inc.

Fittings, Welding.....any type of special fittings made from plate to the most rigid specification. Closer tolerances & quality control. Write for Bulletin 5801.
31 *Midwest Piping Co. Inc.

Hose, Acid....."Commander" can handle the highly corrosive acids & chemicals that quickly eat holes in ordinary acid hose. Write for full information.
222 *B. F. Goodrich Co.

Joints, Expansion.....molded from Teflon, stand higher dynamic pressure and are corrosion-proof. Investigate their full advantages, write for Bul. B-1.
114 *Resistoflex Corp.

Joints, Expansion.....circular or toroidal expansion joint provides lower operating stress. Hydraulically formed—free from circumferential welds. Cat. 56.
63 *Zallea Bros.

Nozzles.....**lightweight,** precision-built steel spray nozzles. Feed just the right amounts of fuel into combustion chamber. Get the complete catalog.
171 *Spray Engineering Co.

Packings.....Teflon packings last longer under corrosive conditions. Ideal for sealing pump & other rotating shafts against acid, caustics, aromatics, etc. Bul. CP552.
188
*Chemical & Power Products, Inc.

Pipe.....CEC transfer system included the transfer lines; vacuum pumps; gauges; vacumm-jacketed valves; traps; and leak detectors. Details contained in Bul. 4-80
206
*Consolidated Electrodynamics

Pipe, PVC.....Tough, rigid, acid-resistant National Polyvinyl chloride pipe comes in two types, normal impact and high impact. Request Bulletin 24.
46 *U.S. Steel Corp.

Tube Cleaners.....Various types to do all jobs quickly and effectively. Write today for details on tube cleaning and maintenance equipment for your needs.
197 *Elliott Co.

Tubing.....send for a copy of the new Trent 48-page tubing handbook. Gives details on applications, special features and uniformity of this tubing.
51 *Trent Tube Co.

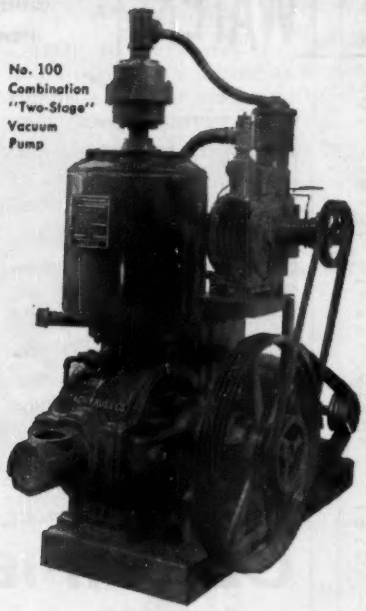
* From advertisement, this issue

the

Beach-Russ

Combination

"TWO-STAGE" VACUUM PUMP



No. 100 Combination "Two-Stage" Vacuum Pump

The Beach-Russ Combination "Two-Stage" Vacuum Pump gives tops in service at the low micron range.

- Faster Pump-Down
- Faster Recovery
- Lower Blank-Off Pressure
- Conditioned Oil Supply
- For Dry or Wet Systems

Write today for NEW "Two-Stage" Bulletin 95

BEACH-RUSS COMPANY
50 Church St. · New York 7, N. Y.

"International" Slow Speed Mixers

WITH NEW SIMPLIFIED PACKAGE MOTOR REDUCER DRIVE



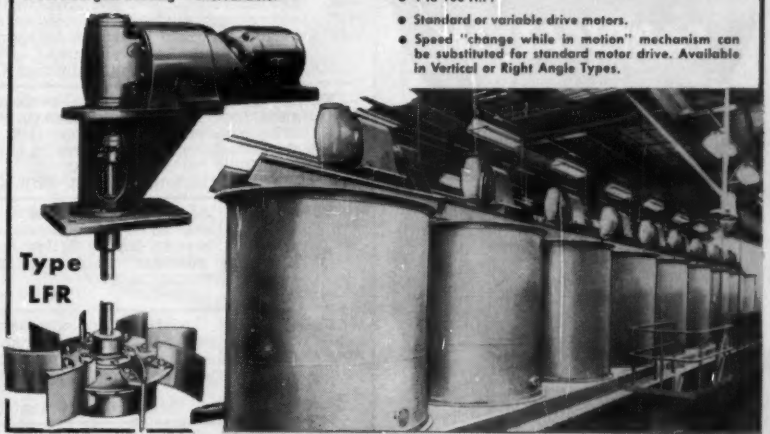
IN VERTICAL AND RIGHT ANGLE TYPES—"International" Package Reducers and Integral Gear Motors provide a brand new, economical and practical answer to most of the problems of Mixer Drive-Head operations. Ratio changes are made in the High Speed Gear Set, ahead of the low speed set, both of which are assembled into a rigid cast iron cage. This subassembly is a complete unit, with gears and bearings, providing easy removal and assessibility.

COMPLETELY INTERCHANGEABLE

No special tools or machine operations required for gear ratio change. Standardized parts provide quick change and low maintenance. Vertical mixer shaft speeds from 1.8 RPM to 230 RPM. HP range from 1 to 30. Uses any standard motor. Long span between bearings insures mixer shaft rigidity. Quiet operation because of ground tooth gears. SPLINED SHAFTS and GEARS provide positive ratio change of gears. Ample overhung load capacity. Positive lubrication. Positive Mechanical Type Oil Seal. Drive head furnished with or without a welded pedestal. Particularly adapted to Turbine operation. Highest Mechanical Efficiency. Ask for Special Bulletin.

International — Type LFR — SLOW SPEED

- Uses any standard motor, Low Head room.
- Mechanical efficiency 96 to 98½ %.
- Speed ranges 1 to 350 RPM.
- Interchangeable speeds.
- All steel gear housing—unbreakable.
- Wide bearing spans increase shaft rigidity.
- Quiet in operation. AGMA ratings.
- 100% starting and momentary overloads.
- Closed or open vessel operation.
- 1 to 100 H.P.
- Standard or variable drive motors.
- Speed "change while in motion" mechanism can be substituted for standard motor drive. Available in Vertical or Right Angle Types.



Type "LFR"—9 unit installation 5 HP Agitated Storage Tanks

MFRS. OF CHEMICAL PROCESSING EQUIPMENT, INDUSTRIAL FANS, STACK FANS, AXIAL BLOWERS, BRICK, TILE AND CERAMIC MACHINERY
Write for Literature

Put your processing problems up to **"International" Engineering, Inc.**

NEW YORK 15 PARK ROW WOrth 2-2580

DAYTON 1, OHIO

HAMMOND TANKS

for LIQUID or DRY STORAGE

above or below ground



CONE ROOF; FLOATING ROOF, DIAPHRAGM AND LIFTER TYPES FOR PRODUCT CONSERVATION



SPHERES FOR GAS AND LIQUID STORAGE

WATER RESERVOIRS ELEVATED TANKS STANDPIPES

and

STEEL PLATE FABRICATION

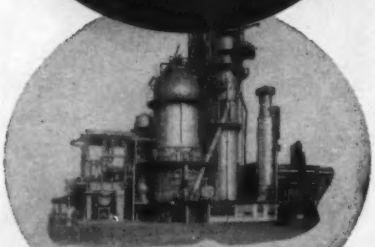


PLATE FABRICATION
STEEL • STAINLESS • ALLOY
CLADMETAL

HAMMOND IRON WORKS

WARREN, BRISTOL and PITTSBURGH, PA.
PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

Sales offices throughout the U. S. A., licensees and sales offices in many foreign countries including Argentina, Belgium, Brazil, Canada, Columbia, Egypt, England, France, Haiti, Italy, Japan, Mexico, Netherlands, Peru and West Germany

LITERATURE . . .

Tubing, Armored.....A polyvinyl chloride sheath over spirally cabled copper provides complete moisture and corrosion protection for tubes. Bul. 356-H.
Br188 *Crescent Insulated Wire.

Pipe, Saran lined.....Economy with the immediate availability of pipe, fittings and valves as stock items. Literature available on pumps and sheeting also.
54 *Dow Chemical Company

Valves.....Write for data on the full SMS line...standard R-S Butterfly valves, Roto valves & Ball valves. Whatever your processing needs or special applications.
218 *S. Morgan Smith

Valves.....Basic-Check units are versatile, dependable & inexpensive. They come in seven standard line sizes, from ⅜" to 2". For details, Bulletin CE88.
184 *Durabla Mfg. Co.

Valves, Ball.....will provide leak-proof sealing in long, trouble-free service. Features quarter-turn opening & closing. For information see Catalog 1000.
164 *W-K-M, ACF Division.

Valves, Control.....features precise control, tight shut-off, compact installation and rugged construction. Smaller control valves also available. Write today.
52 *De Zurik Corp.

Valves, Diaphragm.....Maximum flow, minimum turbulence, negligible pressure drop is insured with these Straightway valves. Information available on request.
64 *Grinnell Co.

Valves, Drain.....the only valves that cannot clog up, designed so that in the closed position the piston or ram extends up into the tank. Request complete catalog.
R169 *Strahman Valves, Inc.

Valve, Forged Steel.....is compact to fit cramped installation areas, without excess weight.....yet safely handles high pressures & temperatures. Write for literature.
49 *Lunkenheimer Co.

Valves, Gate.....Exceptional performance, longer valve life, less maintenance and easier operation. Get all the details on types & sizes in catalog 57.
30 *Darling Valve & Mfg. Co.

Valves, Iron.....features include: corrosion, heat & shock resistance, strength, proven design, & low cost. The new circular on ductile iron valves is available.
112 *Walworth

Valve, Needle.....Improved with fabulous "Teflon" packing. Now enables the needle valve to stand up & work right under pressures up to 10,000 psi.
TL221 *Marsh Instrument Co.

Valves, Nuclear.....Complete separate facilities provide prime source of supply for expanding nuclear industry. Engineering services available. Write.
41 *Alloy Steel Products Co.

Valves, Relief.....for relieving gas or liquid under pressure or vacuum & for maintaining constant pressure on lines, holders & tanks. Bulletin 6500.
Norwalk Valve Co.

* From advertisement, this issue

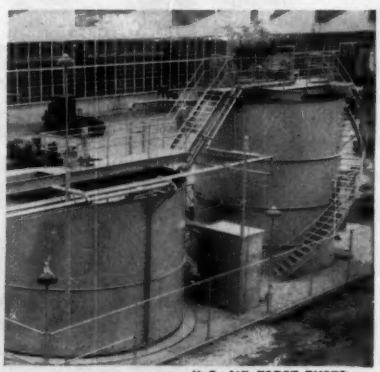
ILLCO-WAY ionXchange

soften
de-alkalize
clarify

WATER

REMOVE

organic matter
turbidity
color
iron



U. S. AIR FORCE PHOTO

HIGH-FLOW, UP-FLOW

CLARIFIER

The Clarifier shown above is part of an ILLCO-WAY ionXchange installation, at a metal-finishing plant, which is used for waste disposal and water recovery. Similar Clarifiers are widely employed to clear up surface waters used by various industries — removing organic matter, hardness, alkalinity, turbidity, color, and iron, as required by specific conditions.

USED AS PRE-TREATMENT

In many instances it is more economical to use a Clarifier in the initial part of a system. Certain water supplies contain organic matter or turbidity which can be removed most efficiently by flocculation, or contain carbonate hardness or alkalinity which can be largely reduced by precipitation — in which situations, a Clarifier is indicated as best. *Let us analyze the water you propose to use, and advise you.*

ILLCO-WAY

ILLINOIS WATER TREATMENT CO.
840 Cedar St.
Rockford, Ill.

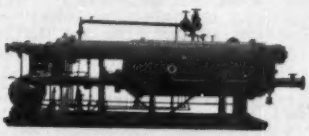
NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Can.

SPECIAL PROCESS EQUIPMENT for the CHEMICAL INDUSTRY



AIR HEATERS

Outlet temperatures from 200° to 3000°. Available as a complete unit, or burner unit only. Any required pressure can be met with oil or gas or both as fuels.



INERT GAS GENERATORS

Operating reports on units now in service show perfect CO_2, no excess air, no unburned combustibles, wide turndown, and completely dependable flame stability. Specially engineered to your specifications.



The John Zink line of process equipment also includes the famous JZ Smokeless Field Flare, Waste Disposal Units, and more than 50 gas, oil and combination gas and oil burners. Special burners and process equipment designed for your individual application.

JOHN ZINK
COMPANY
4401 S. PEORIA
TULSA, OKLAHOMA

LITERATURE . . .

Valves & Fittings.....alloy construction gives ease of operation and low maintenance. Threaded joint eliminates product contact. For details write for Folder.
60 *Cooper Alloy Corp.

Process Equipment

Agitators & Mixers.....for slow speed, thorough stirring, high speed mixing, scrubbing, solvent extraction, solids suspension or aeration of slurries. Bul A2-B4.
196 *Denver Equipment Co.

Agitators, Side-Drive.....are designed to mix or blend your fluids to complete uniformity....with minimum horsepower. Bul. 532 describes a variety of sizes, motor mounts, etc.
182 *New England Tank & Tower Co.

Air Heaters & Gas Generators.....For your individual application, a special line of process equipment. Includes, more than 50 gas, oil & gas & oil burners.
L205 *John Zink Co.

Air Hoists.....This fire-safe air hoist easily handles loaded filter plates. Also, provide easily controlled speed for a swift, steady lift. Bul. 80.
167 *Gardner-Denver Co.

Blenders.....Rotary blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry & semi-dry materials. Bul. 080B.
L207 *Sturtevant Mill Co.

Centrifugals.....the safest you can buy—because of reverse plowing, overload protection, thermal control built-in, curbing & smooth braking. Data No. 2646.
189 *Western States Machine Co.

Crystallizers.....assures you operating advantages that include; lower centrifuging costs, less processing, dust elimination, minimum caking etc. Bul. CE-57.
104 *Struthers Wells Corp.

Dryers.....You can test the drying or reacting of your materials in the continuous atmospheric rotary or fluidized bed dryers. Other equipment available for your needs.
106 *General Amer. Trans. Corp.

Dryers.....Choose Lectrodryer for dependable drying.....whether for drying air, gas or organic liquid. Let our engineers help you select the right equipment.
113 *Pittsburgh Lectrodryer Co.

Dryer.....“Packaged” Hydryer has exclusive features—no waste, full line pressure reactivation and longer adsorbent life. Write for Bulletin 16.0.081.
201 *J. F. Pritchard & Co.

Dust Controls..An efficient dust collecting system, scientifically planned, designed & constructed. Cloth filters bag collectors offer maximum efficiency. Bul. 922.
35 *Pangborn Corp.

Eliminator.....Costly carryover of corrosive liquids entrained in vapor can be stopped easily & economically with Nickel Alloy wire mist eliminators.
108 *International Nickel Co.

* From advertisement, this issue

PUMP PROBLEMS

write

TABER



BEFORE DECIDING ON TYPE OF PUMPS . . .

SEE
TABER
BULLETINS

May avoid costly pump misapplication.

Vertical pump illustrated, for handling chemicals, please request Bulletin V-837. Horizontal Pump, Bulletin C-355.

FIG. 19.488

TABER PUMP CO.
Est. 1859
291 ELM ST.
BUFFALO 3, N. Y.

FIG. 6061

TABER



CEC Transfer Line installation shows temperature of outside pipe only 2°F. different from ambient.

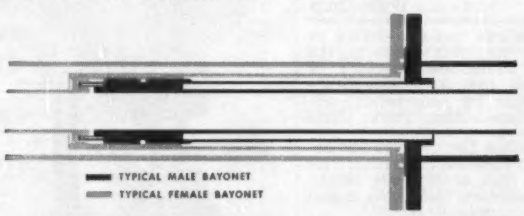
Pipe carries liquid O_2 continuously...why no frost?

This is a pipe within a pipe... with a vacuum in between. Like a Thermos bottle.

Heat transfer from pipe to pipe is only 3 BTU/ft./hr.

Compare this with 186 BTU/ft./hr. for pipe insulated with fiberglass, foamglass, cork, etc.—with 290 for asbestos-insulated pipe—with 340 for pipe insulated with ⅛" frost—and with 600 and above for noninsulated pipe, and you see why CEC vacuum-jacketed transfer lines are ideal for moving liquid rocket and missile fuels.

And the *entire* system is vacuum-tight. Heat transfer is very low even at the joints and flanges, again shown by the absence of frost.



This special bayonet joint, developed by CEC, gives complete and permanent sealing between sections of transfer line. Notice the O-ring groove in the male bayonet and the capturing flange in the female side. The O-ring can never leave the flange. Flanges are machined to a 63 micro-inch finish.

A complete CEC transfer system includes the transfer lines, available-in lengths up to 40 feet in various diameters to meet customer specifications; vacuum pumps; gauges; vacuum-jacketed valves; baffles; traps; and leak detectors.

For complete information contact the nearest CEC sales office. Complete engineering assistance in the field is available.

For preliminary details, write for Bulletin 4-80.

Consolidated Electrodynamics

Rochester Division, Rochester 3, N.Y.

SALES AND SERVICE OFFICES IN PRINCIPAL CITIES

LITERATURE . . .

Evaporator.....is one of the many products manufactured to solve processing problems. Others include; filters, process equipment & contract manufacturing.
R207 *Goslin-Birmingham Mfg. Co.

Filter.....Tilting pan, horizontal filter dewaters & washes 1.4 tons of solids per square foot per hour. Advantages include; corrosion resistance, low operating cost.
4 *Bird Machine Co.

Filters.....FEinc precoat filter is designed for trouble-free operation, dryer cake discharge & high clarity of effluent. Specific recommendations for your problems.
53 *American Machine & Metals

Filter, Air.....Multi-Pak is the most versatile mechanical filter made. Takes a wide variety of renewable media materials, from plant pollen to tobacco smoke. Bul. 237.
99 *American Air Filters

Filter Cloth.....Wedge-shaped openings allow only the filtrate to pass through. Available in variety of weaves, in all malleable metals. Send for new catalog E.
210 *Newark Wire Cloth Co.

Filter Media, Porous Metal.....Fused seams, controlled practical size, greater surface area are the features of this efficient media. Booklets available.
28 *Purolator Products, Inc.

Filters, Oil.....a complete new line with advanced engineering features that give you quick opening covers, low pressure drop, & extra high flow rates. Bul. 101.
206A Commercial Filters Corp.

Filtration Equipment.....Literature available on plate & frame filter presses. Other equipment to meet your filter requirements.
202a *T. Shriver & Co., Inc.

Hastelloy.....offers a high degree of corrosion resistance, it's a natural choice for many applications in today's chemical processes. Write for further information.
6-7 *Vulcan Manufacturing

Kettles.....Write for bulletins on pressure kettle, kettle with centerline scraper agitator, pulp tank, storage tank, vacuum pan or quick cooling pan.
181 *Lee Metal Products Co.

Kilns.....If you need a rotary kiln that is unusual in size, type or application, contact the "kiln specialists". Write for estimates, suggestion and drawings.
30a *Vulcan Iron Works

Mix-Mullers.....Write for a copy of "Mulling in the Chemical Process Industry" for complete information on controlled, intensive mulling without segration of resin binder & sand.
122 *Simpson Mix-Muller Div.

Mixers.....You'll cut processing time, increase mixing efficiency with Readco Mixers. Overlapping action of mixing paddles fully disperses ingredients.
29 *Read Standard

Mixers.....Lightnin Mixer representative can help you get efficient fluid mixing at lowest long-term cost. Write for information on the newest mixing developments.
224 *Mixing Equipment Co.

* From advertisement, this issue

Highly Intimate Blends in 1 to 2 Minutes

Blends while discharging; No segregation or flotation

Sturtevant Rotary Blenders start 4-way blending while charging, continue it during discharge, thus producing highly intimate, even blends of dry and semi-dry materials – within 3 to 5 minutes of start of charging.

Six *complete* blending cycles per hour are common. And Sturtevant's special action produces no particle reduction, cleavage or attritional heat – is highly effective yet gentle and safe even with explosives.



Receiving

Scoops cascade material as drum rotates. Movement forces material from both ends to middle. Thus blending is 4-way right from start of charging.

Discharging

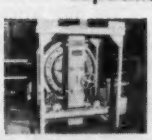
Single gate controls charge, discharge. Blending continues throughout discharge phase. Result is no segregation or flotation — highly intimate, even blends.



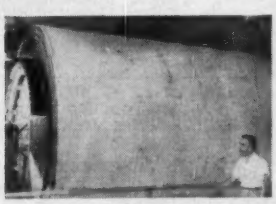
Self-cleaning, dust-sealed drum; one-man accessibility

Operation of Sturtevant Blenders is self-cleaning – drum interiors are completely dust-sealed. For inspection of all models, one man simply loosens a few lugs to remove manhole cover – quickly and easily.

Nine standard models with capacities to 900 cu. ft.



10 cu. ft. Sturtevant Blender at U.S. Steel Corp.'s new Applied Research Laboratory (Raw Materials Division) in Monroeville, Pa. This unit handles batches up to 500 lbs. — is ideal for pilot work and small runs.



One of four 450 cu. ft. Sturtevant Blenders at Celriver Plant of Celanese Corp. (Rock Hill, N. C.). These large units handle up to 20,000 lbs. batches — have a 9-year record of meeting the most exacting blending requirements.

Fully or semi-automatic, or manually controlled operation

Constructed of carbon steel, stainless steel or Monel metal, Sturtevant Rotary Blenders are engineered to fit each customer's needs – can be supplied with injector sprays and any desired control system.

For more on Sturtevant Blenders, request Bulletin No. 080B. (Bulletins also available on Mixers, Air Separators, Micronizers, Crushers and Grinders.) Write today. STURTEVANT MILL CO., 100 Clayton St., Boston, Mass.

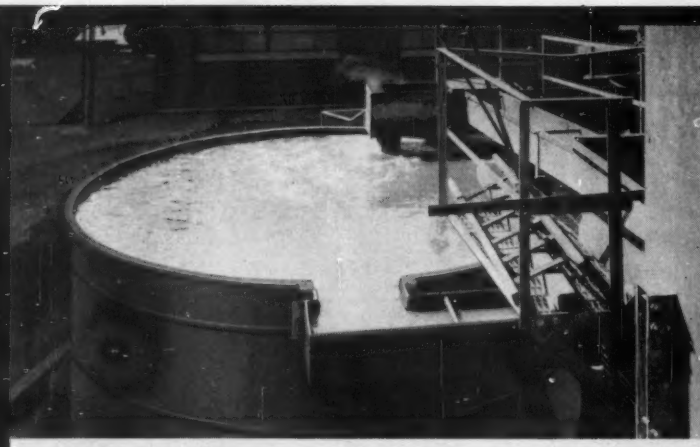


*means Good Business...

This stainless steel evaporator was especially designed for Southern Nitrogen Corporation in Savannah, Georgia. With this economical evaporator, ammonium nitrate is concentrated to 96%. This is another example of Goslin-Birmingham's ability to solve difficult processing problems by applying advanced engineering principles and modern fabrication methods and facilities.

GOSLIN-BIRMINGHAM
MANUFACTURING CO., INC.
BIRMINGHAM, ALABAMA

FILTERS • EVAPORATORS
PROCESS EQUIPMENT
CONTRACT MANUFACTURING
including HEAVY CASTINGS



CHEMICAL STORAGE AND HANDLING WITHOUT COSTLY CORROSION!

Tanks of Beetle's Bonate®

Now, you can store and process corrosive chemicals, without the old corrosion maintenance problems, with tanks fabricated by Beetle of Bonate plastic. The 7,000 gallon "Bonate" tank above has handled selenious acid at 160°F since 1954 without showing a trace of corrosion. The tank shown below has been storing 23% sulphuric acid for over three years at a large western copper refinery and has been maintenance free.

Tanks, covers and hoods of any size can be made of Beetle's Bonate in one piece or in sections for easy installation in confined, cramped areas. Light-weight, non-conductive and temperature resistant, Beetle's Bonate storage tanks and processing equipment deserve your immediate attention. For full information, write now.

CARL N. BEETLE CORP. PLASTICS

145 GLOBE STREET, FALL RIVER, MASS.



LITERATURE . . .

Mixers, Portable.....Especially designed for small batch processes. Eastern's improved line is included in the revised portable bulletin 530-B.
168 *Eastern Industries, Inc.

Process Equipment.....The "A" section of a dictionary of products processed in SW unit machines is available on request. Adapting abrasives, adhesives etc.
45 *Sprout, Waldron & Co.

Process Equipment, Impervious Graphite.....Company's impervious graphite equipment includes rupture disks, chemical pumps, heat exchangers, etc. Bulletin 249.
192 *Falls Industries Inc.

Pulp Press.....Establishing high records of liquid extraction with minimum operating & maintenance costs in materials such as citrus pulp, paper pulp, etc. Bul. Z-47.
208A Jackson & Church Co.

Reboiler.....made of all carbon steel. One of the many products designed & fabricated after many years of experience producing equipment at the lowest possible cost.
174 *Manning & Lewis Co.

Rock Buster.....Bulletin 854 describes operation & application of this hard-hitting giant which breaks down material to the desired size. Stand up in toughest service.
101 *Jeffrey Manufacturing Co.

Screens.....complete line-stainless steel gyratory, heavy duty scalping & standard inclined screens. Write for screen selection guide 26C-6177M.
115 *Allis-Chalmers

Scrubber.....If you have dust or fume control problems where scrubber types of collectors are applicable, investigate the Turbulaire-Doyle scrubber. Write for details.
176 *Western Precipitation Corp.

Steam Jet Ejectors.....are now in use in the petroleum, chemical, power & food industries. Data file M-10-32 will help you with your vacuum equipment needs.
220 *Southwestern Engineering Co.

Tube Mills.....for best grinding in water or acid pulps.....for dry grinding Fillers, Gypsum, Pigments, Carbon Black etc. Complete specifications in Bul. 18-B-11.
190 *Hardinge Co.

Vacuum Retorts.....used for high-temperature vacuum annealing. Rolock facilities & skills cover a wide range of tanks, furnace retorts, fabrications & assemblies.
TR199 *Rolock Inc.

Water Conditioning.....Hot Process provides a water softening process that handles both turbid surface supplies & clear well waters. Publication 4801 gives details.
109 *Cochrane Corp.

Pumps, Blowers, Compressors

Compressor.....The WB two-stage design saves floor space, pump circulates cooling water around cylinders & separate valve chambers. Bulletin WB-10 gives details.
166 *Gardner-Denver Co.

* From advertisement, this issue

Compressor, Engine.....The SUTC gas engine compressors with independent turbocharging are operating in chem., petrochemical plants & pipeline service. Write for details.
67-70 *Worthington Corp.

Compressors.....Built on the Clark originated balanced/opposed principle, provide maximum power on less fuel in minimum space. Wide range of applications. Catalog.
65 *Clark Bros. Co.

Fans.....Type XL advanced design for pressures to 18"SP. Type CI in a wide range of services, pressures to 24"SP. Fans for industrial air & material handling.
44 *Clarage Fan Co.

Pumps.....A complete line including heat transfer, close-coupled and raw sewage pumps....a type size & capacity to fit every liquid-moving need. Bul. available.
32a *Buffalo Pumps

Pumps.....Whatever your pumping needs, vertical pumps for molten chemicals, horizontal pumps for black liquor, caustic, etc. Write for bulletins V-837 & C-355.
R205 *Taber Pump Co.

Pumps.....Bulletin 500, shows specifications, dimensions, construction features & complete selection table for Type GB Frame Mounted, End Suction Pumps.
191 Weinman Pump Co.

Pumps.....Take advantage of low costs, speeded delivery & other outstanding features of SESC line. For detailed information write for Bulletin W-300-B48.
26-27 *Worthington Corp.

Pumps, Centrifugal.....a new series of stainless steel incorporates highest quality material & workmanship to provide low operating & maintenance cost. Bul. 258-1.
209A Ladish Co.

Pump, Chemical.....to end your liquid metering problems. Write for Bul. 440 with typical applications, flow charts, description & specification of models available.
37 *Lapp Insulator Co.

Pump, Hydro-Foil.....for moving water in volume, a most efficient, dependable & economical method. It is available in mixed & axial flow types. Illustrated Bul. B-148.
121 *Peerless Pump Div.

Pumps, Vacuum....Combination "Two-Stage" pump gives outstanding service at low micron range. For both dry and wet systems. Write today for Bulletin 95.
203 *Beach-Russ Company

Services, Processes, Misc.

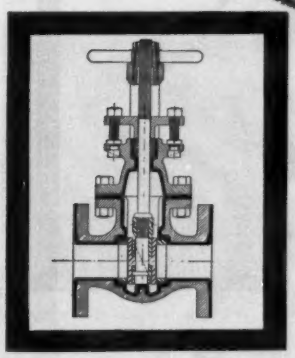
Charts & Layouts.....Statistical charting, office and plant layouts, organization charts, process and flow charts are covered in five manuals on new charting idea.
209B Labelon Tape Co.

Chemical Market Research.....16 p. bulletin illustrates and describes consulting company's facilities in this country and abroad. Numerous photographs.
209C Roger Williams Services

* From advertisement, this issue

Important plus-value

for corrosive service gate valves



Darling rubber-lined gate valves with special alloy working parts (left) are made for pressures to 150 pounds and temperatures to 150°. Other Darling gate valves come in a wide range of sizes, types and constructions for all normal and unusual services.

SURE Darling gate valves are available in the metals or special alloys needed for your particular service . . . and you ought to look into the hard rubber lined iron body type for possible savings. But beyond all that is where the real *plus-value* begins—the result of Darling's fully revolving double disc parallel seat principle!

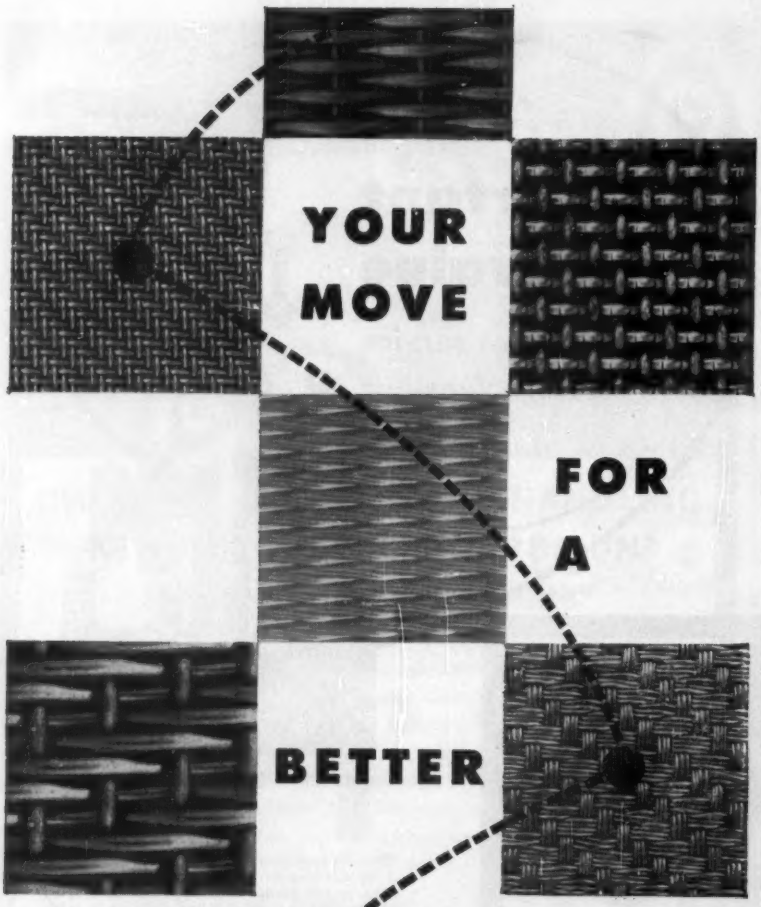
This principle assures uniform wear distribution, automatic seating compensation, and avoidance of disc-to-seat galling. It means prolonged tight closure, much less maintenance and far less chance of process interruptions!

It's easy to get *all* the facts on Darling plus-values. Just ask for new Catalog No. 57.

ENGINEERING SERVICE: Darling offers unusual facilities for the development and manufacture of special valves for out-of-the-ordinary requirements. This special service is available to you at all times, without obligation.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES



Metallic Filter Cloth

NEWARK for ACCURACY

For the most uniform, most accurate metallic filter cloth, specify NEWARK. All weaves, all metals for all types of service, there's a NEWARK filter cloth engineered to meet your requirements. Send for our New Catalog E.

Newark Wire Cloth COMPANY

351 Verona Avenue • Newark 4, New Jersey

LITERATURE . . .

Construction.....Designed & constructed one of the world's largest ethylene plants. Whatever the scope or complexity of your engineering problem.
175 *Stone & Webster Corp.

Disinfectants.....Manufactured products for promotion of health and sanitation. Research & experimentation with insecticides, soap etc. Write for literature.
210A West Disinfecting Co.

Engineering Service.....A firm with a world-wide organization, equipped to cope with situations wherever you plan to construct a new plant or petroleum refinery.
1 *The Lummus Co.

Fume Hoods.....Catalog DH3 illustrates and describes in full detail the history of fume hood control ending with the company's current designs.
210B Duralab Equipment Corp.

Laboratory Equipment.....180 p. Catalog 5-B contains complete information on company's expanded line of metal lab equipment for industrial and research needs.
210C Metalab Equipment Co

Laboratory Instruments.....10 p. catalog describes complete line of centrifuges and other laboratory instruments including rotors, pipettes, stirrers.
210D Ivan Sorvall, Inc.

Laboratory, Instruments.....Lab-Log 2-58, 16 p., decribes a paper electrophoresis system with continuous flow cell for collecting pure fractions.
210E Will Corp.

Odor Control Systems..... Counteractant injects into airstream of odorous exhausts via atomizing nozzle. For a satisfactory solution to problems, write today.
210F Airkem, Inc.

Processing.....Serving the petroleum refining industry, helping to improve operating efficiency & meet the needs of customers. Booklet gives factual information.
210G Universal Oil Products Co.

Reproduction Materials.....48 p. "Index of Photographic Materials for the Reproduction Field" lists types of silver sinsitized papers, films, cloths for engineering drawings.
210H Assn. of Photo Sensitizers

Rhodium Electroplating.....24 p. booklet tells where, when and how to use rhodium electroplate for electrical, electronic and other industrial applications.
210I Sel-Rex Corp.

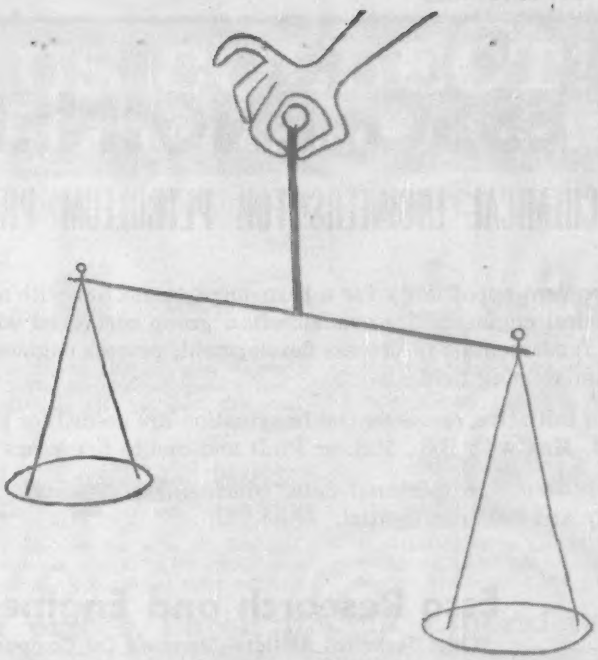
Systems.....Whatever the industry ....whatever the operation, a Kennedy designed system will provide economy of operation & uniformity of product. Data available.
14-15a *Kennedy Van Saun

Tools & Equipment.....Leader in the field with new time-saving tools for specific jobs. Design & develop new equipment for production maintenance throughout industry.
210K Snap-on Tools Corp.

Water Well Systems.....drilled wells provide a reliable water supply. Send for Bulletin No. 100 for full description of efficient, economical wells.
102 *Layne & Bowler Inc.

* From advertisement, this issue

CHEMICAL ENGINEERS ARE DISCERNING PEOPLE



Discernment is as much a part of the chemical engineer's tool kit as his slide rule. He's forever deciding what's of value and what's window-dressing; what works, what doesn't. And Chemical Process Industries firms bet millions each year on his technical judgment.

THAT'S WHY

CHEMICAL ENGINEERING has more engineers on its publishing staff than all other Chemical Process Industries technical magazines put together.

THAT'S WHY

CHEMICAL ENGINEERING's editors carefully screen and investigate each new product before reporting on it to you. This means no wasted time inquiring about old products or products that claim more than they can deliver.

THAT'S WHY

We've questionnaired 1,000 of you every month since 1949 on your interest in our editorial material. And why we've sent personal interviewers to visit thousands of you over the years to learn what you read in CHEMICAL ENGINEERING and why.

THAT'S WHY

CHEMICAL ENGINEERING furnishes a complete all-in-one-place informational service for the chemical engineer. The field's most extensive line-up of work-oriented engineering articles, feature technical reports, vital cost information, news of technology, and practical engineering departments.

THAT'S WHY

In a recent magazine preference study in 29 leading Chemical Process Industry firms, CHEMICAL ENGINEERING received more than half again as many mentions as the next publication... more than 4 times as many "most helpful" votes... from men doing processing and engineering work.

THAT'S WHY

CHEMICAL ENGINEERING is by far the most widely-read, most preferred magazine among chemical engineers. More engineers subscribe to Chemical Engineering than to any other magazine in its field.

Chemical Engineering ABC ABP

McGraw-Hill Building, New York 36, N. Y.

Published every other monday for Chemical Engineers in all functions.

ESSO ENGINEERING

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Komarek-Greaves, 27" dia. x 23" W rolls, 1¼" x 2¼" x 2¼" briquetts. 25 tons/hr., 75 HP motors.
Vulcan Iron Works, 30" dia. x 12½" W. T304 SS roll. 1-15/16" x 1⅛", 7½ tons/hr., 50 HP, 1954.
Komarek-Greaves, 16" dia. x 7½" W. walnut briquetts, 15 HP, 1953.

CRUSHERS

Double-roll, 24" x 24", Gruendler, 20 HP, 1954, spring loaded
Sawtooth, Robinson size #13, 15 HP
Gyratory, Kennedy #49S, 100 HP
Jaw, 8" x 10", Sturtevant
Jaw, 18" x 9", Mitchell, 25 HP

FILTERS, PRESSURE

510 sq. ft., vert., Niagara #510-28, T316 SS (like new!)
151 sq. ft., Sparkler #33-S-28, T304 SS
130 sq. ft., horiz., Hercules #12
110 sq. ft., horiz., Niagara #36H-110-3, T304 SS, 1954, (like new!)
45 sq. ft., vert., Niagara #45-30, T304 SS leaves
Sweetland filters, #12, #7, #5
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MILLS, PULVERIZERS

Hammermill, 400 HP, 47" x 60", Penna. crusher #5060, 1952, UNUSED
Hammermill, 60 HP, Penna. crusher #C-3-30
Pulv. 75 HP, Babcock & Wilcox #E-32
Roller mill, 66" Raymond low-side, 6 roll, 200 HP
Roller mill, Raymond #5057 hi-side
Gyratory crusher, K-VS #49S, 100 HP
Ring type granulator, 40 HP

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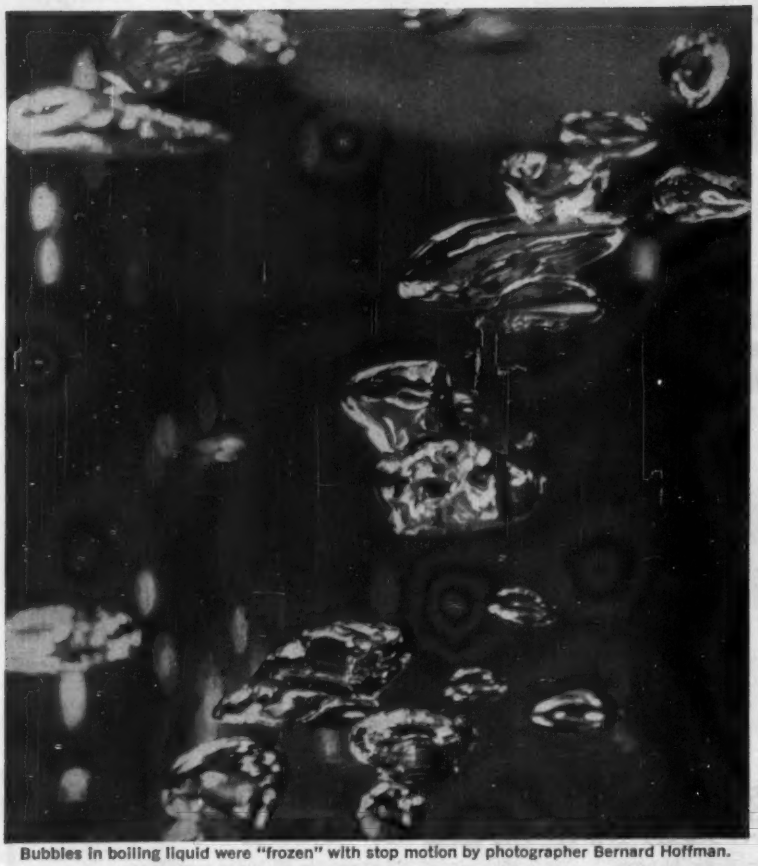
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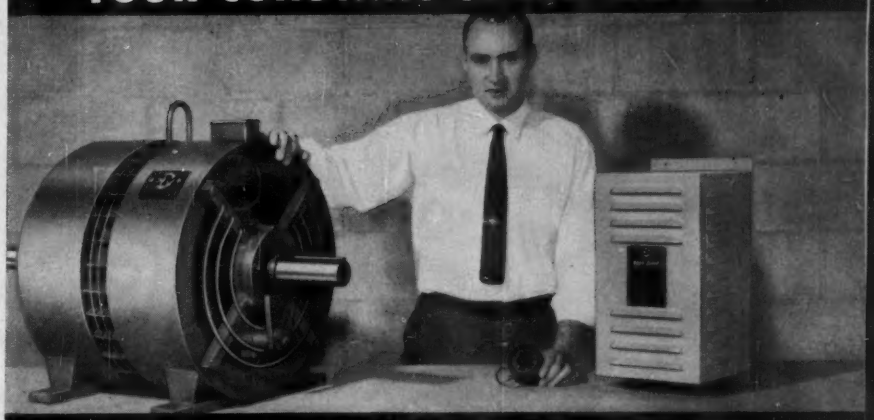
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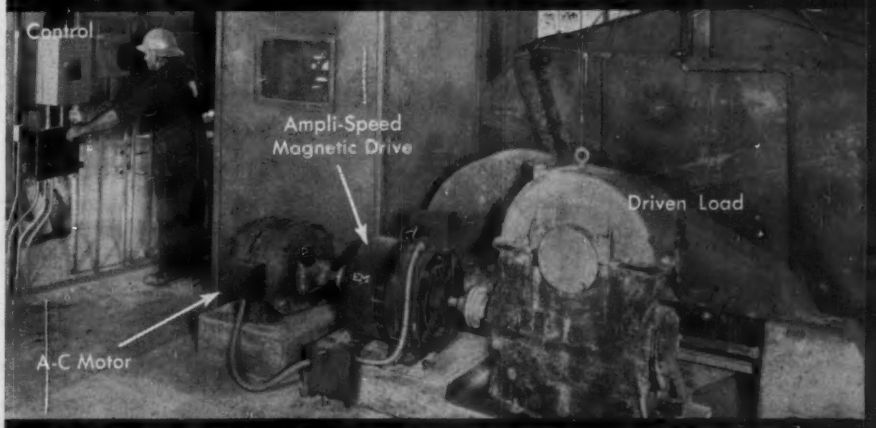
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GIVES ADJUSTABLE SPEED CONTROL

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EASY TO CONTROL – speed is changed by simply turning control potentiometer . . . output may be controlled automatically, too, by pressure, level, or combustion devices.

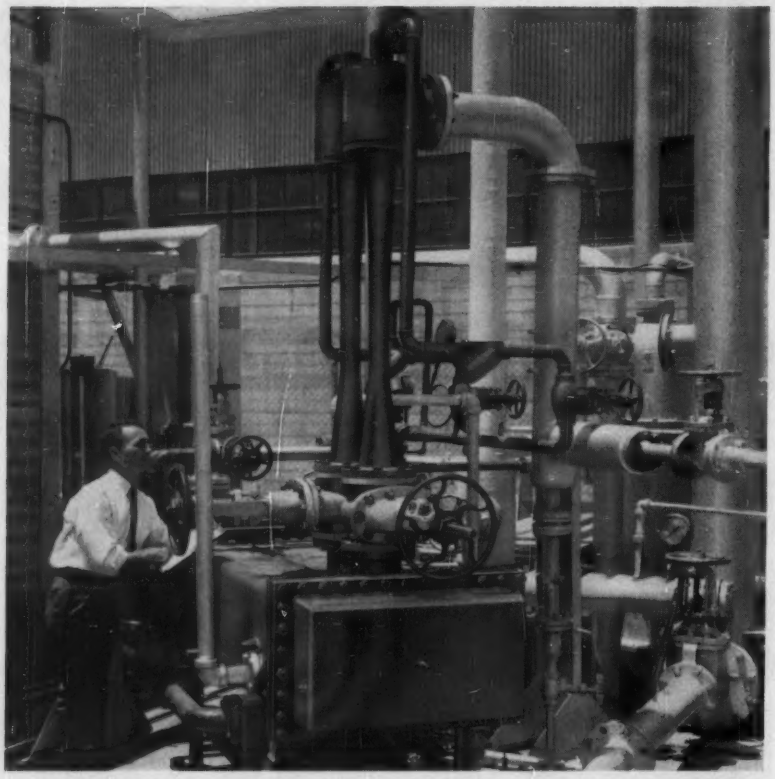
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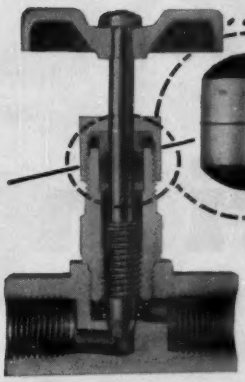
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WESTFIELD, N. Y.

B.F.Goodrich

New B.F.Goodrich acid hose handles highly corrosive acids

B.F.GOODRICH offers "Commander" acid hose, a new hose that can handle the highly corrosive acids and chemicals that quickly eat holes in ordinary acid hose.

For years engineers have been searching for a hose to carry strong oxidizing acids like concentrated sulphuric acid, nitric acid and chromic acid. A new rubber compound that resists these acids has now been developed especially for acid hose. This new rubber, used in the thick tube of B.F.Goodrich Commander acid hose, makes it possible for the hose to last many months or even years in service where ordinary acid hose lasts only a few weeks. This means less downtime, lower operating costs, and reduces the hazards of handling dangerous acids.

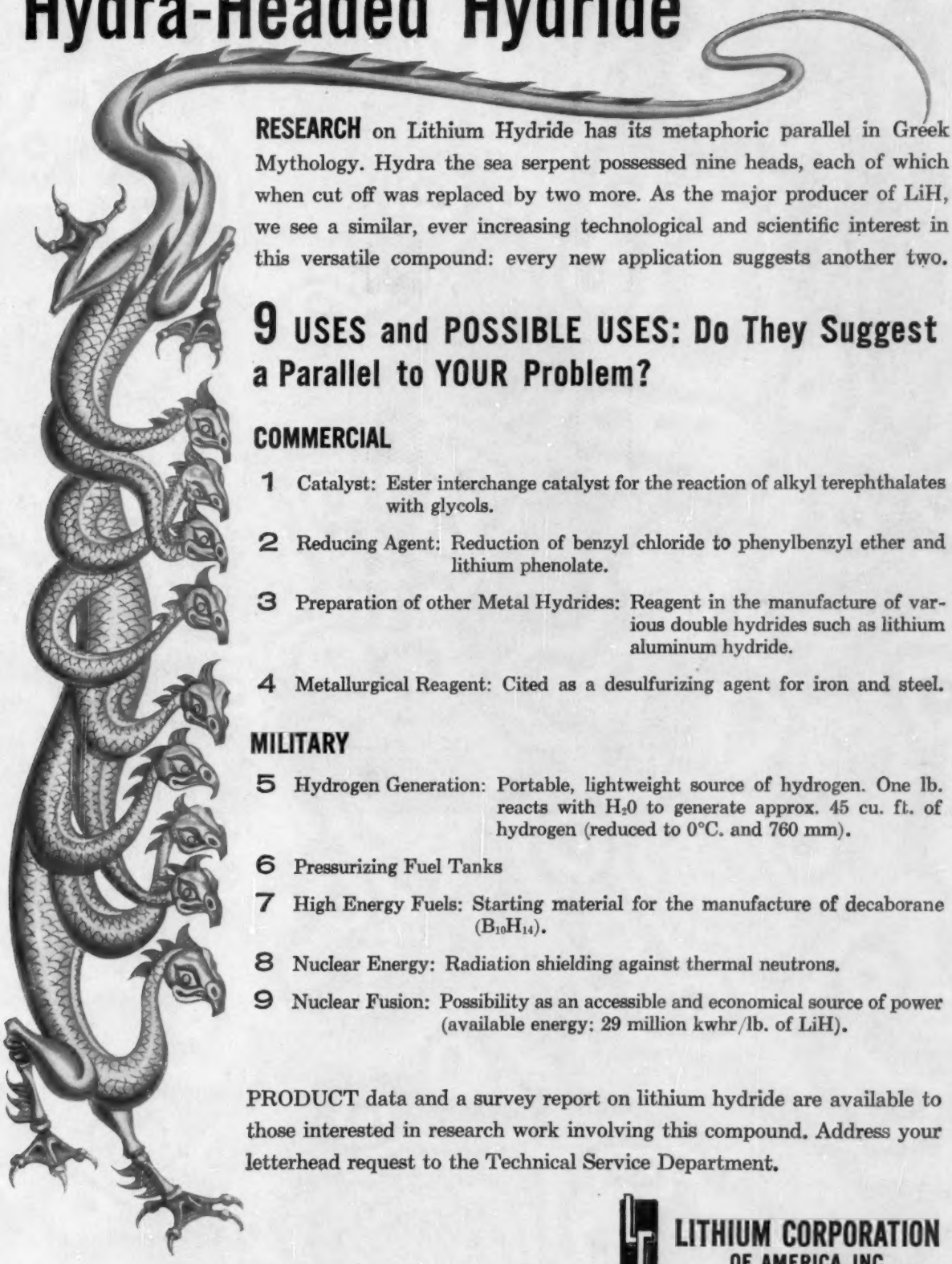
A special rubber compound is also used in the tough, smooth cover of this B.F.Goodrich hose. It gives the hose high resistance to acids, salts, alkalis, abrasion, weather and just about everything else that ruins regular hose.

The new hose comes in two constructions: with or without wire reinforcement. The wire-reinforced hose can be used for both suction and discharge service. It has a heavy spiral steel wire embedded in the rubber that prevents collapse under full vacuum, increases crush resistance. The hose without wire reinforcement is for pinch-valve service, and can also be used to handle acids which form crust on tube that must be broken off by flexing or pounding hose.

Your B.F.Goodrich distributor has full information on the acid hose described here. And as a factory-trained specialist in rubber he can answer all your questions about all the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Company, Dept. M-415, Akron 18, Ohio.*

B.F.Goodrich *acid hose*

Hydra-Headed Hydride



RESEARCH on Lithium Hydride has its metaphoric parallel in Greek Mythology. Hydra the sea serpent possessed nine heads, each of which when cut off was replaced by two more. As the major producer of LiH, we see a similar, ever increasing technological and scientific interest in this versatile compound: every new application suggests another two.

9 USES and POSSIBLE USES: Do They Suggest a Parallel to YOUR Problem?

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PRODUCT data and a survey report on lithium hydride are available to those interested in research work involving this compound. Address your letterhead request to the Technical Service Department.

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